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DL8000 Preset Controller Instruction Manual

Remote Automation Solutions

EMERSON
Process Management

Revision Tracking Sheet

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This manual may be revised periodically to incorporate new or updated information. The revision date of each page appears at the bottom of the page opposite the page number. A change in revision date to any page also changes the date of the manual that appears on the front cover. Listed below is the revision date of each page (if applicable):

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Contents

Chapter 1 – Overview **1-1**

1.1 DL8000 Overview 1-1
1.2 Hardware 1-3
1.2.1 Housing 1-3
1.2.2 Electronics 1-5
1.3 Technical Specifications 1-5

Chapter 2 – Installation and Use **2-1**

2.1 Housing 2-1
2.1.1 Class I Zone 1 Housing 2-1
2.1.2 Securing the Cover to the Class I Zone I Case 2-4
2.1.3 Class I Div 2 Housing 2-5
2.2 Card Cage 2-5
2.2.1 Backplane 2-6
2.3 Central Processor Unit (CPU) 2-6
2.3.1 Installing and Removing Wire Channel Covers 2-9
2.3.2 Removing and Installing Module Covers 2-9
2.3.3 Removing the CPU Module 2-10
2.3.4 Installing the CPU Module 2-11
2.4 License Keys 2-11
2.4.1 Installing a License Key 2-12
2.4.2 Removing a License Key 2-13
2.5 Installation Planning 2-13
2.6 Mechanical Installation 2-14
2.6.1 Planning Considerations 2-15
2.7 Electrical Installation 2-17
2.7.1 General Considerations 2-17
2.7.2 Field Wiring Installation Guidelines: 2-17
2.7.3 Electrical Wire and Cable Selection and Installation 2-18
2.7.4 Input/Output Field Signal Wiring 2-19
2.7.5 Electrical Grounds 2-19
2.7.6 Wire Conduit Selection and Installation 2-20
2.8 Operator Interface 2-22
2.8.1 Keypad 2-23
2.8.2 LED Status Indicators 2-24

Chapter 3 – Modules **3-1**

3.1 Power Input Module 3-1
3.1.1 12 Volt DC Power Input Module 3-2
3.2 Input/Output Modules 3-3
3.2.1 General Installation 3-5
3.2.2 Installing an I/O Module 3-6
3.2.3 Removing an I/O Module 3-6
3.2.4 Wiring I/O Modules 3-7
3.2.5 Analog Input (AI) Modules 3-7
3.2.6 Analog Output (AO) Modules 3-9
3.2.7 Discrete Input (DI) Modules 3-10
3.2.8 Pulse Input (PI) Modules 3-12
3.2.9 Discrete Output (DO) Modules 3-14

3.2.10 Discrete Output Relay (DOR) Modules 3-15
3.2.11 Resistance Temperature Detector (RTD) Input Modules 3-17
3.2.12 Alternating Current Input/Output (AC I/O) Module 3-18
3.2.13 Advance Pulse Module (APM) 3-23
3.2.14 Thermocouple (TC) Input Module 3-27
3.2.15 Highway Addressable Remote Transducer (HART®) Module 3-30
3.3 Communication Modules and Ports 3-32
3.3.1 Wiring Communications 3-34
3.3.2 Local Operator Interface (LOI – Local Port) 3-35
3.3.3 Using the LOI 3-36
3.3.4 Ethernet Communications 3-36
3.3.5 EIA-232 (RS-232) Serial Communications 3-38
3.3.6 EIA-422/485 (RS-422/485) Serial Communications Module 3-39
3.3.7 EIA-422/485 (RS-422/485) Jumpers and Termination Resistors 3-40
3.3.8 Dial-up Modem Communications Module 3-41
3.4 Additional Technical Information 3-43

Appendix A – Glossary **A-1**

Appendix B – Modbus Communications **B-1**

B.1 Modbus Communications B-1
B.2 Modbus Configuration B-2
B.2.1 Modbus Configuration General Tab B-3
B.2.2 Modbus Configuration Scale Values Tab B-5
B.3 Modbus History B-7
B.3.1 Modbus Configuration History Table Tab B-8
B.4 Modbus Events & Alarms Functionality B-11
B.4.1 Reading Events & Alarms Register B-11
B.4.2 Acknowledging Events & Alarms B-11
B.5 Modbus Registers B-12
B.5.1 Modbus Configuration Registers Tab B-14
B.5.2 Modbus Conversion B-17
B.6 Modbus Master Table B-19
B.6.1 Modbus Configuration Master Table Tab B-20
B.7 Modbus Master Modem B-22
B.7.1 Modbus Configuration Master Modem Tab B-22
B.8 HMI Information B-24
B.8.1 Sequential Blending B-24
B.8.2 Ratio Blending B-25

Appendix C – Wiring Diagrams **C-1**

C.1 Daniel Senior Sonic Meter to PI Module C-1
C.2 Daniel 1818A and 1838 Turbine Pre-Amp to PI Module C-2
C.3 Micro Motion RFT9739 & 2400S Transmitters to PI Module C-3
C.4 Micro Motion RFT9739 & 2400S Transmitters to APM Module C-4
C.5 3- and 4-Wire RTD to RTD Module C-5
C.6 Daniel Senior Sonic Meter to APM Module C-6
C.7 Daniel 1818A and 1838 Dual Turbine Pre-Amp to APM Module C-7
C.8 Daniel 1818A and 1838 Turbine Pre-Amp to APM Module C-8
C.9 Two-Stage Valve with Two Limit Switches to APM Module C-9

Appendix D – Communications Protocols **D-1**

D.1 Introduction D-1
D.1.1 Communication Channels D-2

D.1.2 Communications Failure D-2
D.1.3 Supported Protocols D-3
D.1.4 Configuration D-5
D.1.5 Commands D-6
D.1.6 Status Flags D-7
D.2 Batch Control in Auto Mode D-8
D.2.1 Steps for Authorizing a Transaction D-8
D.2.2 Steps for Authorizing a Batch D-11
D.2.3 Stop/End of Batch D-12
D.2.4 End of Transaction D-13
D.2.5 Batching Status States D-14
D.3 Communications Commands D-15
D.3.1 Modbus Commands D-15
D.3.2 DanLoad 6000 Protocol Commands D-30
D.4 Mapping Modbus Registers D-73
D.5 DanLoad 6000 Protocol Frame D-76
D.6 BCC Calculation D-77
D.7 CRC-16 Checksum Table D-78
D.8 Status Flags Description [63,0,119] D-79
D.9 Exception Codes D-84
D.10 New/Unused DanLoad 6000 Exception Codes D-86
D.11 Alarm Logs D-87
D.12 Error Codes D-89

Appendix E – DL8000 Keypad Display **E-1**

E.1 Keypad Display Components E-1
E.1.1 Keypad E-2
E.1.2 LED Status Indicators E-4
E.1.3 Liquid Crystal Display (LCD) E-5
E.1.4 Power Failure E-5
E.1.5 Operational Modes E-6
E.2 Loading Mode E-6
E.2.1 Recipe Selection E-6
E.2.2 Invalid Recipe Selection E-7
E.2.3 Additive Selection E-7
E.2.4 Data Item Prompt E-7
E.2.5 Preset Quantity E-8
E.2.6 Invalid Preset E-8
E.2.7 Loading E-8
E.2.8 Transaction End Prompt E-9
E.2.9 Conditional String Display for Temperature Correction String E-10
E.3 Program Mode E-11
E.3.1 ROCLINK 800 Configuration E-11
E.3.2 Log In E-13
E.3.3 Initial Menu E-13
E.3.4 Clear Alarms E-14
E.3.5 Select Language E-14
E.3.6 Print Record E-14
E.3.7 Display Setting E-15
E.3.8 Current Status E-16
E.3.9 Setup/ Configuration E-19
E.3.10 Generic TLP for Setup and Status E-40
E.3.11 Online Help E-43
E.4 Calibration E-45
E.4.1 Calibrating Additive Meters E-45
E.4.2 Calibrating Analog Input E-49
E.4.3 Calibrating RTDs E-51

E.4.4 Calibrating Product Meters E-55
E.5 Diagnostics E-71
E.5.1 Diagnosing Digital Outputs (DO) E-71
E.5.2 Diagnosing Digital Inputs (DI) E-74
E.5.3 Diagnosing Analog Outputs (AO) E-77
E.5.4 Diagnosing Analog Inputs (AI) E-81
E.5.5 Diagnosing AC Input/Outputs (AC I/O) E-85
E.5.6 Diagnosing RS-232 Communication Ports E-89
E.5.7 Diagnosing RS-485 Communication Ports E-91
E.5.8 Error Messages E-96
E.5.9 Translated Alarm and Status Messages E-97

Index **I-1**

Chapter 1 – Overview

This manual, the *DL8000 Preset Controller Instruction Manual* (Form A6212), provides operational information for the DL8000, and contains the following chapters:

Chapter 1 General Information	Provides an overview of the functions and hardware for the DL8000.
Chapter 2 Installation and Use	Provides installation and usage information on the components of the DL8000, including the housing, card cage, and CPU. This chapter also addresses installation issues.
Chapter 3 Modules	Provides information on the Power Input, Input/Output (I/O), and communication modules available for the DL8000.
Appendix A	Provides a comprehensive glossary of terms.
Appendix B	Provides information on Modbus communications.
Appendix C	Provides sample wiring diagrams for several Emerson devices.
Appendix D	Provides information of alternative communications protocols.
Appendix E	Provides information on using the DL8000 keypad display.
Index	Provides a topical index to the manual.

1.1 DL8000 Overview

The DL8000 can be operated in an independent, stand-alone mode with the operator controlling and monitoring batch delivery operations from the control panel located on the front of the unit.

Note: Although the DL8000 can also function as a slave unit in a terminal automation system (TAS) network, this manual **only** discusses local operation of the DL8000 in the **stand-alone** mode.

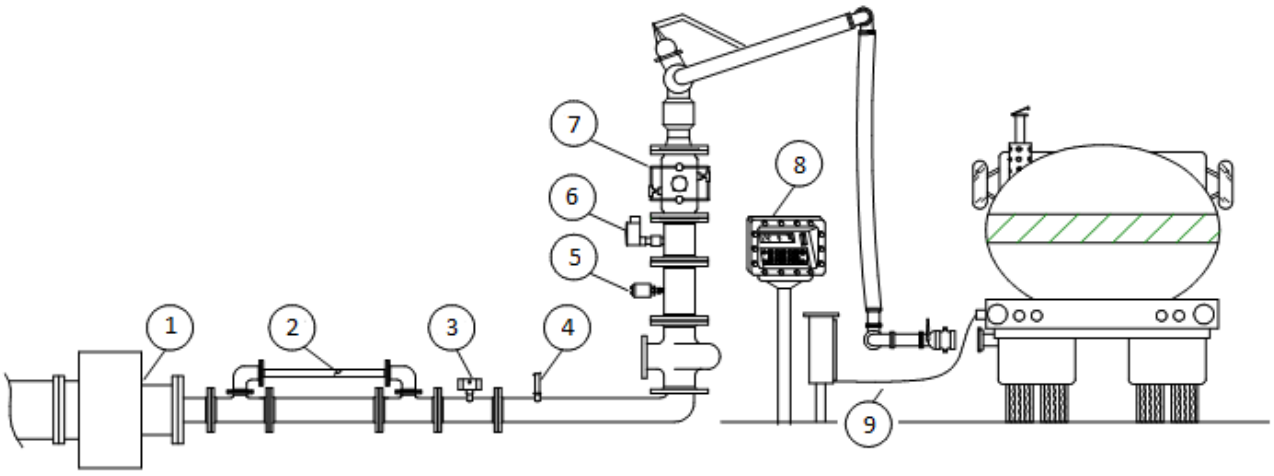
The DL8000 accepts process input signals from and provides process control signals to the common instruments and devices used in liquid batch delivery systems. These instruments and devices include:

- Liquid flow meters (volumetric or mass inputs from a turbine, Coriolis, ultrasonic, or other flow measurement devices using single or linearized meter factors).
- Solenoid-controlled digital flow control valves (both digital and 2-stage).
- Additive injectors.
- Security devices for verifying electrical ground connections and compartment overfills.

- Electric motor driven pumps.
- Motor operated block valves.

You can easily configure the DL8000 to deliver single component liquids or to blend up to four liquid components in precise ratios, with or without additive injection. Operator-selectable predefined delivery control procedures ("recipes") control the DL8000's various possible delivery and blending functions. Additive injection is controlled by manual selection, recipe selection, or automatic selection from a terminal automation system. These features allow one DL8000 and the associated liquid delivery equipment to deliver many different combinations of liquid products, based on requirements of the client or receiver of the delivered product.

One common DL8000 application is to function as an on-site controller for delivering refined liquid hydrocarbon products from loading terminal storage tanks to mobile tanks (such as tanker trucks, rail cars, or barges). Other applications include liquid component blending and / or additive injection in refinery or chemical plant processes. In addition, liquid components (with or without additive injection) can be blended into flowing pipelines or into storage tanks. *Figure 1-1* shows a typical load rack installation with a DL8000 and associated equipment.



1: Pump Control Output
2. Density Transmitter
3. Pressure Transmitter
4. Additive Injection Output(s)
5. Meter Pulse Output
6. Temperature Probe
7. Valve Control
8. DL8000
9. Permissive Contacts

Figure 1-1. Typical DL8000 Load Rack

⚠ Warning

Overfill protection is critically important to your site. If your site DOES NOT have overfill protection hardware installed, DO NOT set the Overfill Limit Quantity value (defined on the Alarm Setup tab of the Preset Setup screen in the Batching program) to zero. Setting that field to zero DISABLES overfill protection. Remote Automation Solutions is not responsible for damage resulting from disabling this critical safety feature.

Factory Default Configuration

The DL8000 is factory-configured with a basic set of communication and I/O modules to accommodate process I/O signals.

The default I/O module load—as well as any optional modules—is determined during initial purchase. However, the I/O modules and communications modules mix is field-reconfigurable, within the limits of the DL8000's central processing unit (CPU). The hardware configuration determines the DL8000's capacities for I/O signal handling and the data logging/data communications.

Logical Functions

The flow measurement and logical functions listed below are available in all hardware configurations of the DL8000. However, each unique installation requires a specific complement of I/O modules, based on the actual devices the DL8000 monitors and controls.

The DL8000 can simultaneously monitor and control operation of up to three flow meters, up to three flow control valves, and deliver up to four products. The minimum configuration consists of one flow meter measuring one component (liquid product), one control valve, one pump start, and one permissive input. Product deliveries and component blending deliveries are selected by up to 30 configurable recipes (batch delivery/blending control procedures). The actual implementation of the various possible process operations are covered in detail in other sections of this manual.

1.2 Hardware

The DL8000 has two primary physical components: the external housing and the internal electronics. Refer to *Chapter 2, Installation and Use*, for details on installation.

1.2.1 Housing

The DL8000 uses either of two external housings:

- A cast aluminum casing with stainless steel front cover bolts. It is flame-proof (in accordance with Class I, Zone 1, Group IIB) and weatherproof (in accordance with IP66).
- A 14-gauge stainless steel box with 12-gauge stainless steel mounting flanges, CSA-rated as a Type 4 enclosure. The door is made of 0.090 inch thick aluminum secured to the box with a stainless steel piano hinge and two stainless steel spring latches.

Note: For specific details, refer to the technical specification *DL8000 Preset* (form DL8000), available at *www.EmersonProcess.com/Remote*.

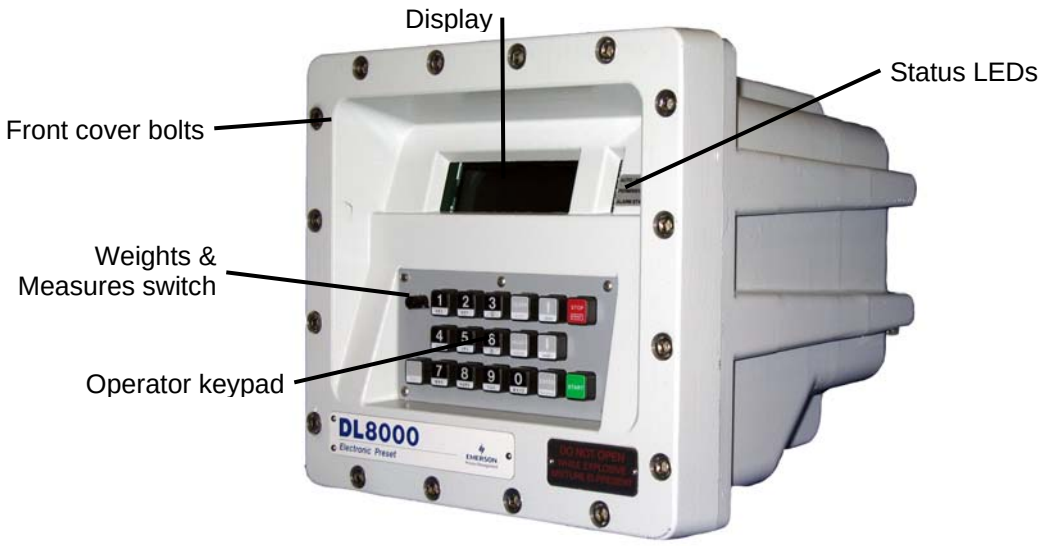


Figure 1-2. DL8000 (in Class I, Zone 1 Enclosure)

Sixteen stainless steel front cover bolts (M10 – 1.5 metric) secure the lid to the housing. Two of the front bolts are longer and drilled close to the threaded ends, allowing placement of Weight & Measures seal wires to prevent undetected access to the electronics.

Bolt holes are tapped to 13 mm (0.50 inches); require an 8 mm (5/16-inch) Allen wrench, and torque to 24 to 29 Newton/meters (18 to 21 foot/pounds) of force.

The operator keypad provides 18 rugged, Hall-Effect pushkeys which are impervious to chemicals commonly associated with petroleum applications. A sealable Weights & Measures switch provides security to flow measurement parameters.

Secured behind non-glare glass, the liquid crystal display (LCD) provides an 8-line by 40-column message area for operator interface. The display uses a photo sensor and temperature sensor which can be set to automatically adjust contrast and backlighting for optimal viewing.

Light-emitting diodes (LEDs) displaying the status of alarms, operating mode, and permissive powers are located to the right of the display.

With the front cover bolts removed, the lid hinges down to reveal the electronic compartment.

1.2.2 Electronics

The DL8000's CPU sits inside the cast aluminum enclosure. The DL8000 uses a highly innovative and versatile CPU with a backplane to which the CPU, Power Input module, input/output (I/O) modules, and communication modules connect. The DL8000 unit has nine module slots, three of which (slots 1, 2, and 3) can house communication modules.

The DL8000 uses a 12 volt dc Power Input module to convert 120 to 250 V ac external input power to the voltage levels required by the unit's electronics and to monitor voltage levels to ensure proper operation. For more information on the Power Input module, refer to *Chapter 3, Modules.*

The DL8000 supports a number of I/O modules, which can satisfy a wide variety of field I/O requirements (refer to *Chapter 3, Modules*). I/O modules include:

- Analog Inputs (AI).
- Analog Outputs (AO).
- Discrete Inputs (DI).
- Discrete Outputs (DO).
- Digital Output Relay (DOR).
- Alternating Current Input/Output (ACIO).
- Advance Pulse Module (APM).
- Pulse Inputs (PI) – High/Low Speed.
- Resistance Temperature Detector Inputs (RTD).
- Thermocouple (TC)
- HART®

In addition to the built-in serial interface (the Local Operator Interface, or LOI) and an Ethernet connection, the DL8000 also supports the following communications modules:

- EIA-232 Serial Communications.
- EIA-422/485 Serial Communications.
- Dial-up Modem.

1.3 Technical Specifications

For further technical information on the DL8000, refer to the technical specification *DL8000 Preset*, (form DL8000), available at *www.EmersonProcess.com/Remote.*

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Chapter 2 – Installation and Use

This chapter describes the DL8000's external housing, its internal electronic components (the ROC800-Series CPU), and the specifics of mechanical and electrical installation.

2.1 Housing

The DL8000 uses either of two external housings:

- A cast aluminum casing with stainless steel front cover bolts. It is flame-proof (in accordance with Class I, Zone 1, Group IIB) and weatherproof (in accordance with IP66).
- A 14-gauge stainless steel box with 12-gauge stainless steel mounting flanges, CSA-rated as a Type 4 enclosure. The door is made of 0.090 inch thick aluminum secured to the box with a stainless steel piano hinge and two stainless steel spring latches.

2.1.1 Class I Zone 1 Housing

The DL8000 Class I Zone 1 housing is cast aluminum that, when appropriately sealed, provides a flame-proof enclosure. Sixteen threaded stainless steel fasteners secure the lower portion of the housing to the hinged lid, which contains the display panel, operator keypad, and LED status display. See *Figures 2-1* and *2-2*.

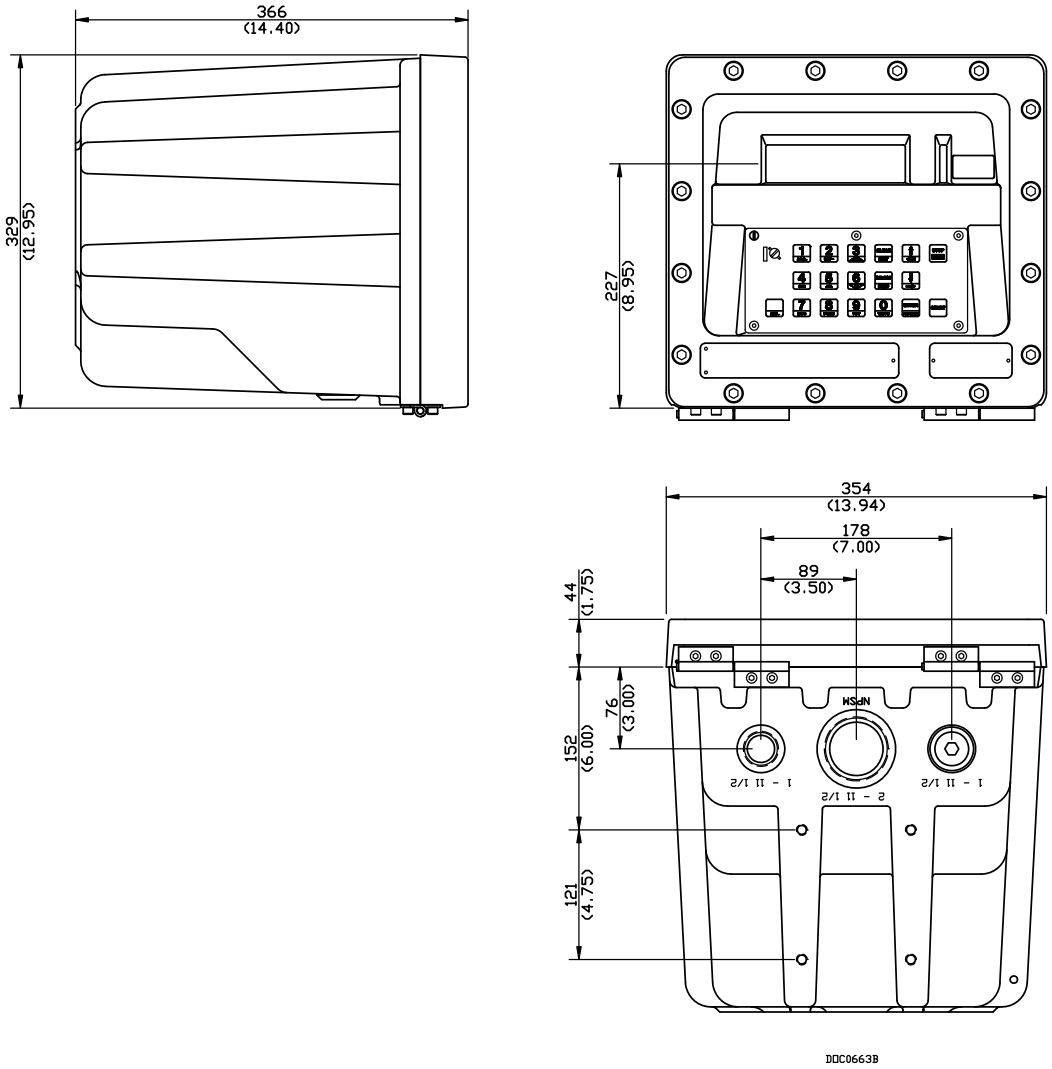


Figure 2-1. Standard DL8000 Enclosure

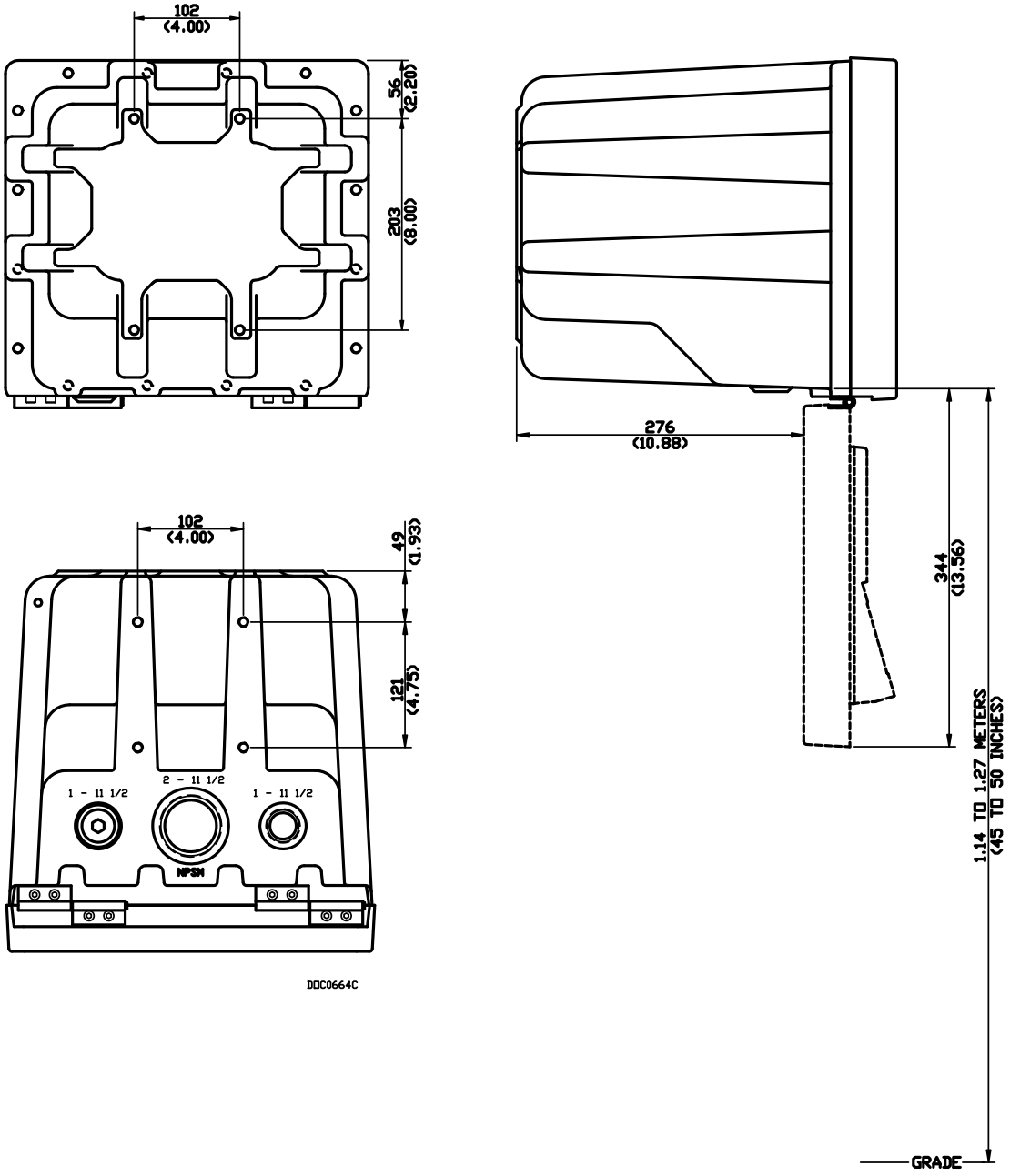


Figure 2-2. Standard DL8000 Enclosure

Note: The four mounting holes on the bottom and back of the DL8000 case accept 10M (10mm) bolts.

The DL8000's design makes it highly adaptable to a wide variety of installations. Consequently, this manual cannot cover all possible installation scenarios. Contact your local sales representative if you require information concerning a specific installation not described in this manual.

Planning is essential to a good installation. Because installation requirements depend on many factors (such as the application, location, ground conditions, climate, and accessibility), this document only provides generalized guidelines.

2.1.2 Securing the Cover to the Class I Zone I Case

The DL8000 ships from the factory with the cover secured to the case with one stainless steel fastener ("bolt"). The remaining bolts are bagged and included with the DL8000. You must install **all** bolts.

⚠ Warning **Failure to install ALL cover bolts will compromise the flame-proof characteristics of the enclosure.**

⚠ Caution **The flanges between the case and the cover create a flameproof joint. Before you secure the cover to the case, make sure the surfaces are clean and free of damage.**

To secure the DL8000 cover:

Notes:

- You must use a torque wrench for this procedure.
- The bolt in position 9 (see *Figure 2-3*) is factory-installed. Be sure that the bolts you install in positions **12** and **8** are the two longer bolts with pre-drilled holes (for the Weights & Measures seal wires).

1. Swing the DL8000 cover up against the case.
2. Insert a bolt in position 1 (refer to *Figure 2-3*) and finger-tighten the bolt until you feel resistance.
3. Insert a bolt in position 2 (refer to *Figure 2-3*) and finger-tighten the bolt until you feel resistance.
4. Repeat step 3 for bolts in positions 3 through 16.
5. Using a torque wrench, tighten the bolt in position 1 to specifications (24 to 29 Newton/meters or 18 to 21 foot/pounds of force).
6. Tighten bolts in positions 2 through 16 to specifications.

⚠ Caution **Tighten the bolts in the numeric order shown in *Figure 3-3* to prevent deforming the cover and risking the integrity of the seal between cover and case. You must install all the bolts.**

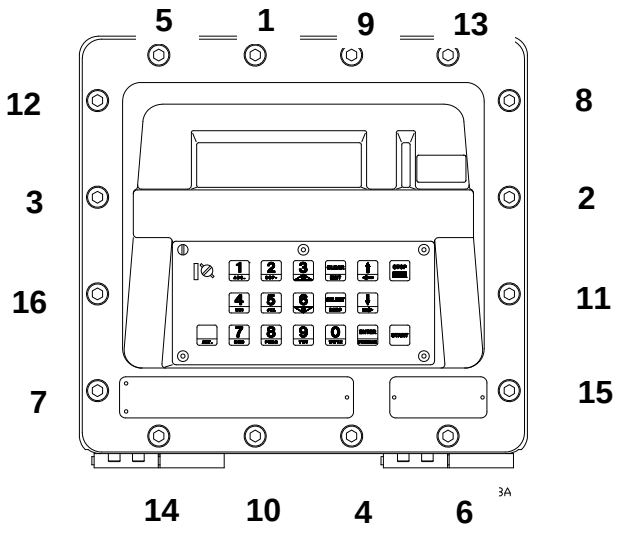


Figure 2-3. Bolt Tightening Sequence

2.1.3 Class I Div 2 Housing

The Class I, Division 2 housing includes a 14 gauge stainless steel box with 12 gauge stainless steel mounting flanges. The door is made of .090 inch thick aluminum and is secured to the box via a stainless steel piano hinge and two stainless steel spring latches. The latches include features for padlocking or installing wire seals. The assembly includes a door stop that locks the door in position at approximately 120 degrees from the closed position. The viewing window in the enclosure door is made from scratch / UV resistant polycarbonate/acrylic blend (PC/PMMA). The keypad bezel is mounted to the front of the door and is made from UV resistant polycarbonate. The assembly is rated by CSA as a Type 4 enclosure.

2.2 Card Cage

The DL8000 uses electronic modules which fit into a card cage. The card cage rests inside the cast housing. See *Figure 2-4* for a view of the card cage as it would appear when the housing is opened.

The card cage provides a backplane with sockets for installing a main processor board, a DC power supply, up to nine process I/O boards, and up to three communications cards. The card cage (see *Figure 2-4*) supports a total of **nine** boards, in addition to the power supply and the CPU.

Note: Board placement is critical for I/O assignments during startup. Refer to *Chapter 3, Modules*, for further information.

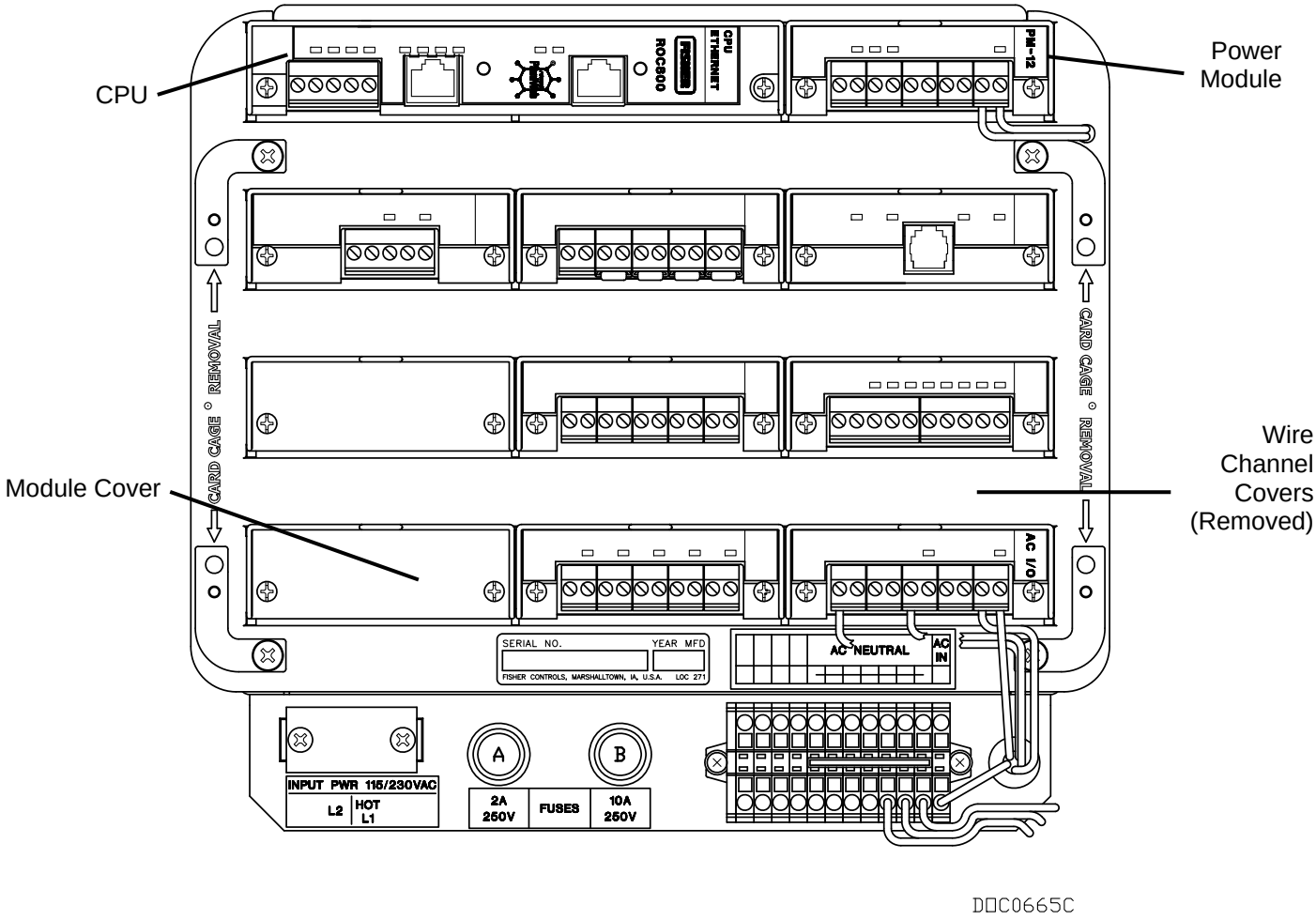


Figure 2-4. Card Cage (with modules)

2.2.1 Backplane

The backplane has connectors for the CPU, the power input module, and all the I/O and communication modules. When a module is completely inserted into the module slot, the connector on the module fits into one of the connectors on the backplane. The backplane does not require any wiring, and there are no jumpers associated with the backplane.

Removing the backplane from the housing is not recommended, as there are no field-serviceable parts. If the backplane requires maintenance, please contact your local sales representative.

2.3 Central Processor Unit (CPU)

The CPU contains the microprocessor, the firmware, connectors to the backplane, three built-in communication ports (two with LEDs), a LED low power wakeup button, a RESET button, the application license key connectors, a STATUS LED indicating system integrity, and the main processor. See *Figure 2-5*.

The 32-bit microprocessor is based on a Motorola® MPC862 Quad Integrated Communications Controller (PowerQUICC™) PowerPC® processor running at 65 MHz (in the Series 2 CPU module) or 50 MHz (in the Series 1 CPU module).

The internal Sanyo 3 volt CR2430 lithium backup battery provides backup of the data and the Real-Time Clock when the main power is not connected.

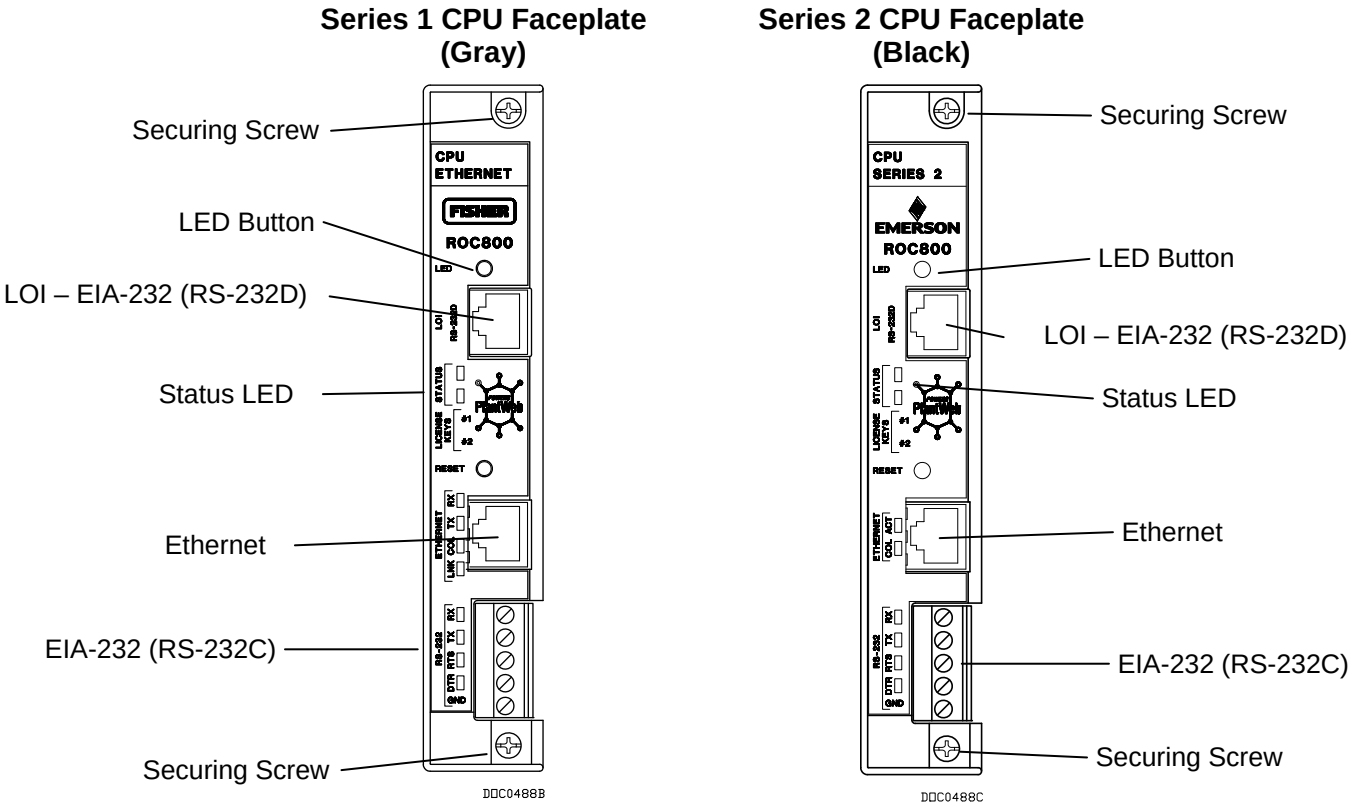


Figure 2-5. CPU Front View (Series 1 and Series 2 CPU Modules)

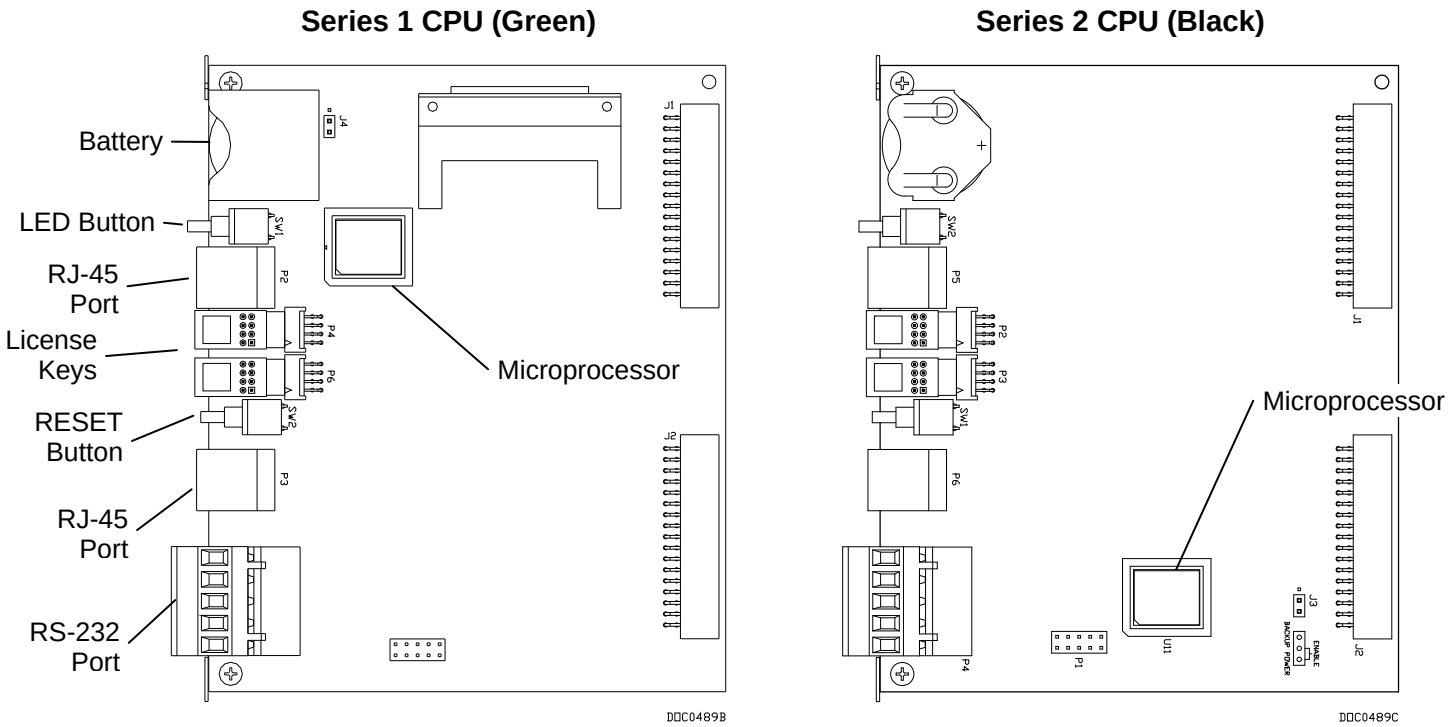


Figure 2-6. CPU Connectors

Table 2-1. CPU Connector Locations

CPU Number	Series 1	Series 2
J1	Backplane connector	Backplane connector
J2	Backplane connector	Backplane connector
J3	Not Used	Battery Backup
J4	Battery Backup	Not Used
P2	LOI Port RJ-45	License Key Terminal
P3	Ethernet RJ-45	License Key Terminal
P4	License Key Terminal	RS-232
P5	Not Used	LOI Port RJ-45
P6	License Key Terminal	Ethernet RJ-45
SW1	LED Button	RESET Button
SW2	RESET Button	LED Button

The CPU contains a microprocessor supervisory circuit. This device monitors the battery voltage, resets the processor, and disables the SRAM chip if the voltage goes out of tolerance. The CPU has an internal Analog to Digital Converter (A/D). The A/D monitors the supply voltage and board temperature. The CPU has two buttons (see *Figure 2-6*):

- **LED** – Press to turn on the LEDs on the CPU module, I/O modules, and communication modules when the DL8000 has timed out.
- **RESET** – Press to reset the DL8000 system to defaults.

The STATUS LED indicates the integrity of the DL8000. Refer to *Table 2-2*.

Table 2-2. STATUS LED Functions

Status LED	Color	Definitions	Solution
Continually Lit	Green	DL8000 functioning normally.	N/A
Continually Lit	Red	Low Battery Voltage alert.	Charge battery.
		System AI (Point number 1) LoLo Alarm.	Apply DC voltage source.
Flashing	Green	Firmware invalid.	Update firmware.
Flashing	Green-Green to Red-Red	Firmware update in decompression.	**Do not** restart the DL8000.
Flashing	Green to Red	Firmware update is flashing image.	**Do not** restart the DL8000.

As a power-saving feature, you can enable or disable the LEDs on the DL8000 (with the exception of the LED on the power module). You can also use the ROCLINK™ 800 software to configure how long the LEDs remains on after the LED button on the CPU module is pressed. For instance, with the default setting of five minutes, all LEDs go off after five minutes. If you press the LED button, LEDs become active again for five minutes. If you enter a 0 (zero) setting, they always stay active.

2.3.1 Installing and Removing Wire Channel Covers

The DL8000 includes wire channel covers (see *Figure 2-4*) you install over the wiring channels once you complete wiring the terminal blocks on the modules.

To install a wire channel cover:

1. Align the wire channel cover over the wire channel, allowing unobstructed wire access.
2. Press the wire channel cover into place until it snaps.

Note: The tabs on the top side of the wire channel cover should rest in the slots on the top edge of the channel.

To remove a wire channel cover:

1. Grasp the wire channel cover at both the left and right ends.
2. Start at the left or right and pull the wire channel cover out of the wire channel.

2.3.2 Removing and Installing Module Covers

Before you insert an I/O or communications module, remove the module cover (see *Figure 2-4*) over the empty module slots in which you intend to install the modules. Although you are not required to remove the power to the DL8000 to perform this procedure, caution is always advisable when working with a powered DL8000.

⚠ Caution **To avoid circuit damage when working inside the unit, use appropriate electrostatic discharge precautions (such as wearing a grounded wrist strap).**

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

To remove a module cover:

1. Remove the wire channel cover.
2. Unscrew the two captive screws on the face of the cover.
3. Using the tab at the top side of the module cover, lift the module cover from the DL8000.

Note: If you remove a module for an extended period, install a module cover over the empty module slot to keep dust and other matter from getting into the DL8000.

To install a module cover:

1. Place the module cover over the module slot.
2. Tighten the two captive screws on the face of the cover.
3. Replace the wire channel cover.

2.3.3 Removing the CPU Module

To remove the CPU module:

⚠ Caution **Failure to exercise proper electrostatic discharge precautions (such as wearing a grounded wrist strap) may reset the processor or damage electronic components, resulting in interrupted operations.**

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

1. Back up critical data.

Note: "Critical" data may include your device configuration file, device alarms and events history, or displays.

2. Remove power from the DL8000.
3. Remove the wire channel cover.
4. Unscrew the two captive screws on the front of the CPU module and remove the faceplate.
5. Place a small screwdriver under the ejector clip at the left or right of the CPU module and lightly pry the CPU module out of its socket. You may find it easiest to carefully pry on the left ejector clip a

little, and then carefully pry the right ejector. You will feel and hear the CPU as it detaches from the backplane.

6. Remove the CPU module carefully. Make sure not to pull on any cables attached to the CPU module.

2.3.4 Installing the CPU Module

To install the CPU module:

⚠ Caution **Failure to exercise proper electrostatic discharge precautions (such as wearing a grounded wrist strap) may reset the processor or damage electronic components, resulting in interrupted operations.**

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

1. Slide the CPU module into the slot.
2. Press the CPU firmly into the slot, ensuring the ejector clips rest on the module rail guides. The connectors at the back of the CPU module fit securely into the connectors on the backplane.
3. Place the CPU faceplate on the CPU.
4. Tighten the two captive screws on the faceplate of the CPU module firmly.
5. Replace the wire channel cover.
6. Return power to the DL8000.

2.4 License Keys

License keys with valid license codes grant access to applications or, in some cases, allow optional firmware functionality to execute. In some situations, a license key may also be required before you can run the application. Examples of licensed applications include DS800 Development Suite software, meter run calculations, and various User C programs (such as LiquidCalcs in this application). You can then configure these applications using ROCLINK 800 or the DS800 Development Suite software.

The term "license key" refers to the physical piece of hardware (see *Figure 2-7* and *Figure 2-8*) that can contain up to seven different licenses. Each DL8000 can have none, one, or two installed license keys. If you remove a license key after enabling an application, the firmware disables the task from running. This prevents unauthorized execution of protected applications in a DL8000.

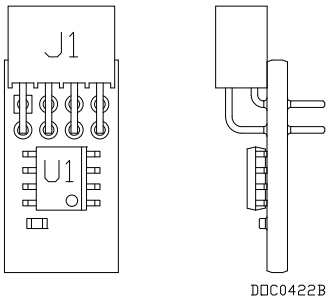


Figure 2-7. License Key

2.4.1 Installing a License Key

Note: For the DL8000, license keys are a factory-installed option. Under normal operation, you should not need to install, remove, or replace a license key.

To install a license key:

Caution

Failure to exercise proper electrostatic discharge precautions (such as wearing a grounded wrist strap) may reset the processor or damage electronic components, resulting in interrupted operations.

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

1. Back up critical data.

Note: "Critical" data may include your device configuration file, device alarms and events history, or displays. Refer to *Saving and Retrieving Configurations* in the *ROCLINK 800 Configuration Software User Manual*, Form A6121, for further information.

2. Remove power from the DL8000.
3. Remove the wire channel cover.
4. Unscrew the captive screws from the CPU faceplate and remove it.
5. Place the license key in the appropriate terminal slot in the CPU (see *Figure 2-6*).

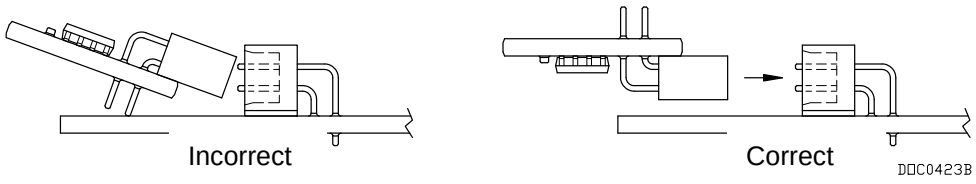


Figure 2-8. License Key Installation

Note: If you are installing a **single** license key, place it in the uppermost slot (closest to the LOI port).

6. Press the license key into the terminal until it is firmly seated (refer to *Figure 2-8*).
7. Replace the CPU faceplate and tighten the two captive screws.
8. Replace the wire channel cover.
9. Restore power to the DL8000.

2.4.2 Removing a License Key

To remove a license key:

Caution

Failure to exercise proper electrostatic discharge precautions (such as wearing a grounded wrist strap) may reset the processor or damage electronic components, resulting in interrupted operations.

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

1. Back up critical data.

Note: "Critical" data may include your device configuration file, device alarms and events history, or displays. Refer to *Saving and Retrieving Configurations* in the *ROCLINK 800 Configuration Software User Manual*, Form A6121, for further information.

2. Remove power from the DL8000.
3. Remove the wire channel cover.
4. Unscrew the two captive screws on the CPU faceplate and remove it.
5. Remove the license key from the appropriate terminal slot in the CPU (see *Figure 2-8*).
6. Replace the CPU faceplate and tighten the two captive screws.
7. Replace the wire channel cover.
8. Restore power to the DL8000.

2.5 Installation Planning

Installation planning is very important due to the DL8000's physical and functional reconfigurable capabilities. Installation planning consists of the following three major tasks.

- Assure that the DL8000 contains the required number and type of process I/O boards to monitor and control the other devices in the product delivery system.
- Determine the functions the DL8000 will perform. You selectively enable these functions during the DL8000's configuration procedure.
- Design the mechanical/electrical installation with special consideration for both the operator's safety and ease-of-use and the maintenance technicians' safety and ease-of-access to instruments and devices.

2.6 Mechanical Installation

In planning the physical installation of the DL8000, consider ease of use of the instrument with the operator in a safe and comfortable position. Also consider how maintenance tasks may be performed without disrupting ongoing product delivery operations in close proximity. Drawing rough diagrams of normal operator actions during the different possible batch delivery related tasks may be helpful. Note especially the operator's location in relation to the location of one or two tanker vehicles and their related loading arm and bottom loading hose connections.

Some location or position restrictions may be present when a DL8000 is retrofitted or upgraded into an existing installation. However, mechanical installation planning should still be performed. It may be possible to correct an existing inconvenient controller mounting location in a current loading rack installation when retrofitting a DL8000 at the installation.

Following are the major steps performed during installation.

1. Plan the installation.
2. Fabricate device supports and lay electrical conduit.
3. Mount the DL8000 and other load rack devices.
4. Run and connect all wiring.
5. Verify and tag each wire.
6. Seal conduit within 50 mm (2 inches) of the DL8000.

   Note: Install certified conduit plugs in any unused entries.

7. Secure cases and covers of all devices.
8. Apply electrical power.
9. Configure (set up) the DL8000 and any other devices as required.

10. **Disable product block valves and additive block valves to prevent any product or additive flow.** Then verify system monitor and control functions with dry piping.
11. **Enable one product block valve at a time and one additive injection system at a time.** Then verify the piping integrity and system operation in increments for **each** product and **each** additive handling system.
12. Perform meter proves to determine DL8000 meter calibration.

2.6.1 Planning Considerations

Consider the following points during DL8000 mechanical installation planning:

- **Maintenance Access**

  The operator panel is hinged at the bottom side and opens down for maintenance access. Route all conduit to the rear, sides, or bottom of the unit. Do not locate any object under the DL8000 or in front of the conduit connections for a distance of approximately 533 mm (21 inches) below the instrument.

- **Mounting Height**

  Recommended mounting height is approximately 1.14 to 1.27 meters (45 to 50 inches) above grade to the bottom of the DL8000 case (see *Figure 2-2*). Mounting height determines the ease of viewing the display panel and ease of use of the keypad.

- **Mounting Position**

  North/south/east/west orientation of the operator control panel is somewhat predetermined by the loading facility design. Consider the location of the operator in relation to one or two tanker vehicles present and connected at the loading island.

- **Mounting Fixtures**

  You must fabricate mounting fixtures for the DL8000. Each DL8000 comes with four M10-1.5 x 15 mm metric thread bolts for mounting. You can either rear-mount or bottom-mount the DL8000, although bottom-mounting is preferred due to the DL8000's weight. The mounting attachment should be a 4 mm (0.16 inch) (minimum) thick mild steel member with four 11.5 mm (0.44 inch) diameter holes that match the bolting pattern being used. The steel member may be sheet, angle, channel, or another shape.

  Center the forward pair of mounting screw holes in bottom-mount fixtures no more than 19 mm (0.75 inch) from the edge. The case has a taper to the rear. The standard case may need a shim at the rear pair of screws to level the DL8000. Level the case to allow for the best conduit alignment.

- **Special Installation Considerations**

  The DL8000 is designed for installation in an outdoor environment. The instrument is weatherproof and explosion-proof in accordance with applicable standards. Some of the following installation suggestions concerning environmental protection describe accepted engineering practices and should not be considered to be limitations on the utility of the instrument.

  - If the loading rack or loading island area is covered, locate the DL8000 so that the operator is protected or partially protected from direct rainfall.
  - In ***tropical climates***, place sunshades above the DL8000 and other electronic instruments, such as process transmitters. Locate sunshades to prevent direct sunlight on the instruments during the hottest part of the day (10:00 to 15:00). Construct sunshades of metal, fiberglass, or other suitable materials. Sunshades should be rear-sloping to direct rain to the rear of the instrument and away from the operator. Avoid sharp edges or corners on sunshades to prevent injuries.
  - In ***desert areas or areas of blowing sand***, install a cover to protect the operator control panel during idle time. Continuous blowing sand over an extended period of time can sandblast the display panel and pushkey legends, affecting readability. Fabricate a cover from raw materials or use a modified NEMA 4 weatherproof enclosure with a sealed rear cutout, placing it over the operator panel. Use care in the design of any hinged cover so that wind gusts do not move the cover and cause injuries. Any cover design must allow for maintenance access to the DL8000. The operator panel is hinged to open in the down direction for maintenance access.
  - In ***areas of continuous high humidity***, place a 76.2mm x 76.2mm (3-inch x 3-inch) desiccant pack inside the DL8000 case. Place desiccant packs so that any expansion due to moisture absorption does not interfere with any of the equipment or wiring inside the case. Two sources of desiccant packs are:
    - Waterguard® Desiccants
      PO Box 1079
      16023 I-10 East, Suite 30
      Channelview, TX 77530
    - A+ Corporation
      40462 Highway 42
      Prarieville, LA 70769

2.7 Electrical Installation

⚠ Caution **Shut off all sources of AC and DC power to the loading island site before installing the DL8000.**

2.7.1 General Considerations

Use any of three cable entries located on the bottom of the housing for wiring access to the DL8000.

- A threaded 25.4 mm (1-inch) female NPSM connection on the left side of the unit (for AC power and control / status signals).
- A spare threaded 25.4 mm (1-inch) female NPSM connection on the right side of the unit (may be used for meter pulse wiring to segregate meter pulse wiring from all other signals).
- A threaded 50 mm (2-inch) female NPSM connection for DC cabling and low voltage level signals in the center.

⚠ Caution **Seal all cable entries within 50 mm (2 inches) of the enclosure with suitable sealing or potting compound.**

2.7.2 Field Wiring Installation Guidelines:

- Route external AC and DC wiring in separate conduits.
- Record cable and wire routing and interconnection information to simplify the creation of as-built documentation for the system.
- Provide remote circuit breakers and optional disconnect switches for all AC and DC power input circuits.
- Follow power and signal field wiring grounding standards.
- Use only stranded copper wire, equal to or of larger gauges as indicated on the basic wiring diagrams located at the rear of this section. Take care not to cut or weaken wire strands during the removal of insulation.
- Clearly mark all wire ends with slip-on wire tags or similar devices. Preferably, color-code the wire tags to indicate the voltage level and mark tags with the specific signal name.
- Cut power and signal wires with an additional length of approximately 50 mm (2 inches) for service loops to allow terminal board and connector removal.
- Position all wiring within the unit to avoid unnecessary crimping and overcrowding and to insure proper clearance for the instrument door and hinges.

- After completion, thoroughly check the wiring to insure that input AC power and all field I/O signals are correctly connected at the DL8000 terminations and at the terminations located on the corresponding field device.

2.7.3 Electrical Wire and Cable Selection and Installation

All wiring must conform to the National Electrical Code; to local, state, or other jurisdictions; and to company standards and practices. Following are recommendations for 115/230 Volts ac power wiring:

- Use multi-strand copper conductor wire and cable when connecting the DL8000 to the power source and the field devices.
- Ensure that all wire and cable is in new condition and adheres to the manufacturer's quality standards with the size, type of insulation, and voltage rating.
- Use the following recommended wire types and sizes for AC power input to the DL8000:
  - Power feed should be 100 or 240 Volts ac, 50 to 60 Hertz, single phase, three-wire. Locate a 15 Amp circuit breaker and optionally a power disconnect switch in a safe area.
  - Use wire size AWG 14 for power feed for distances up to 250 feet.
  - Use wire size AWG 12 for power feed for distances of 250 to 500 feet.
  - Use wire size AWG 10 for power feed for distances of 500 to 1000 feet.

    Note: Power feed distances greater than 1000 feet are **not** recommended.

  - Single-conductor wiring must be THWN type, which is moisture and heat-resistant thermoplastic with nylon jacket, approved for dry-and-wet locations, and has a maximum operating temperature of 75 degrees Celsius (167 degrees Fahrenheit). The wire or cable jacket must contain the Underwriters Laboratories, Inc. mark for Gasoline and Oil Resistant, II.
- Ensure that shielded wires and cables for meter pulse signals have shield-drain wires. The shield-drain wires must not be more than two AWG sizes smaller than the conductors for the cable. The shield-drain wire must be connected to ground at only one end of the run.
- Connect RS-485 serial data signals via two twisted pairs with overall shield, AWG 28 to AWG 22. Ideally, the capacitance should not be greater than 16 pF per foot (Belden 9842 for example). The use of a signal common (ground) conductor connected to each

device is a recommended option. Capacitance greater than 16 pF per foot may be used at reduced baud rates and/or with shorter data communication cable runs.

- Use AWG 28 to AWG 18 RS-232 single ended serial data signals for cable lengths up to 15 meters (50 feet).
- Ensure that all cables have either Teflon® or PVC exterior jackets.
- Install insulated wire and cable in accordance with the manufacturer's recommendation. Do not exceed maximum wire tension, maximum insulation pressure, or minimum bending radius.
- Use suitable lubrication during wire pulls in conduit to prevent wire stress.
- Place cable or wire markers at the terminations of all cables and individual wires. Markers should contain the specific wire or cable codes designated for that particular circuit. The wire and cable markers should be legible and permanent.
- Check all wiring connected to the DL8000 for continuity, proper size, and proper classification. Verify the source or destination of each circuit before connecting to the DL8000 and related devices.

2.7.4 Input/Output Field Signal Wiring

Following are recommendations for process signal wiring:

- Use metal conduit for all process signal wiring.
- Use separate conduits for AC and DC voltage circuits.
- Ensure that all process signal wiring is a single, continuous length between field devices and the DL8000, unless the length and/or conduit runs require that multiple pulls be made. In these instances, interconnect the individual conductors with suitable terminal blocks.

2.7.5 Electrical Grounds

Following are recommendations for electrical grounds:

- A clamp type ground lug is located on the inside bottom front of the case. Chassis ground conductors (color code green) inside the DL8000 enclosure should be stranded, insulated, copper wire. Connect these device chassis ground conductors to the clamp type ground lug.
- A clamp type ground lug is located on the outside of the case at the rear of the lower right (facing the operator panel) casting rib. Connect this ground point to a copper ground rod as described below.
    - Connect a single-point ground (the outside case ground lug) to a copper-clad, ten-foot long, 19 mm (0.75 inch) diameter steel rod,

which is buried, full-length, vertically, into the soil as close to the equipment as is practical. (Grounding rod furnished by others.)

Note: We recommend cad welding the wire to the rod to ensure proper grounding.

- Resistance between the copper-clad steel ground rod and the earth ground must not exceed 25 ohms. If necessary, additional ground rods may be driven into the ground, while a spacing of not less than 1.8 meters (6 feet) is used to separate each of the ground rods. Additionally, the ground rods must be interconnected with a continuous stranded wire, sized as indicated below.
- When several DL8000 units are located in close proximity, each single-point equipment ground must be inter-connected to the single point grounds of the other DL8000s. These inter-enclosure equipment grounding connections must be "daisy-chained" so that only one point of the grounding daisy-chain is connected to the actual ground rod.

- Size the equipment-grounding conductors used between DL8000 units and the copper-clad steel ground rod or for inter-enclosure equipment ground connections according to the following specifications:
  - Stranded, insulated, copper wire size AWG 8 for distances of less than 4.5 meters (15 feet).
  - Stranded, insulated, copper wire size AWG 6 for distances of 4.5 to 9 meters (15 to 30 feet).
  - Stranded, insulated, copper wire size AWG 4 for distances of (9 to 30.5 meters (30 to 100 feet).
  - All inter-enclosure equipment-grounding conductors should be protected by metallic conduit.
  - Shield-drain wires should be connected to ground at only one end of the shielded conductor run.
  - External equipment (such as data printers or terminal automation systems which are connected to the DL8000) should be powered via isolation transformers to minimize the ground loops caused by the internally shared safety and chassis grounds.

2.7.6 Wire Conduit Selection and Installation

Following are recommendations for conduit installation:

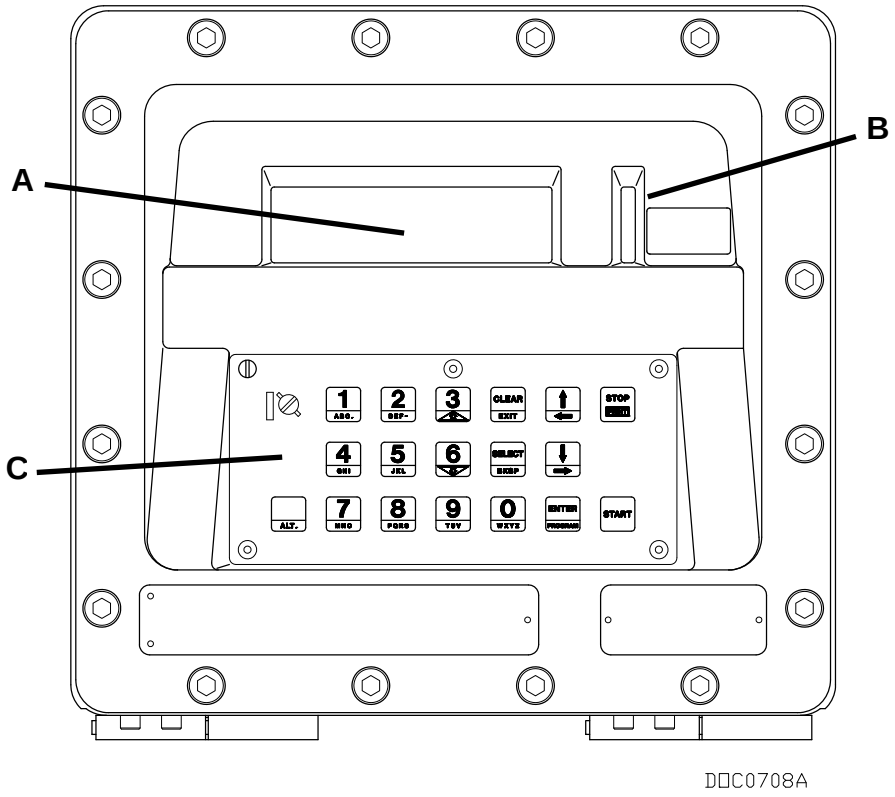
- Ensure that all conduit and the associated assembly and installation materials used for the installation of the DL8000 are in new condition and adhere to the manufacturer's quality standards.

- Ensure that all conduit runs have an explosion-proof sealing (potting) fitting located within 50 mm (2 inches) distance from the conduit entrance to the DL8000.
- Ensure that the conduit installation is vapor tight, with threaded hub fittings, sealed conduit joints and gaskets on covers, or other approved vapor-tight conduit fittings.
- Square all conduit cutoffs. Cutoffs must be made by a cold cutting tool, hacksaw, or by some other approved means that does not deform the conduit ends or leave sharp edges.
- Coat all conduit fitting threads, including factory-cut threads, with a metal-bearing conducting grease (such as Crouse-Hinds STL or equivalent) prior to assembly.
- Temporarily cap the ends of all conduit runs immediately after installation to prevent accumulation of water, dirt, or other contaminants. Swab out conduits prior to installing the conductors.
- Where applicable, install explosion-proof seals in the conduit.
- Install drain fittings at the lowest point in the conduit run and install seals at the point of entry to the DL8000 to prevent vapor passage and accumulation of moisture.
- Use liquid tight conduit fittings (such as Myers Scru-tite® or equivalent) for conduit which is exposed to moisture.

2.8 Operator Interface

Note: Refer to *Appendix E, DL8000 Keypad Display*, in this manual for a complete discussion of the features and functionalities of the DL8000 keypad display.

The DL8000's keypad display has the following parts:



A: Display

B: LED Status Indicators

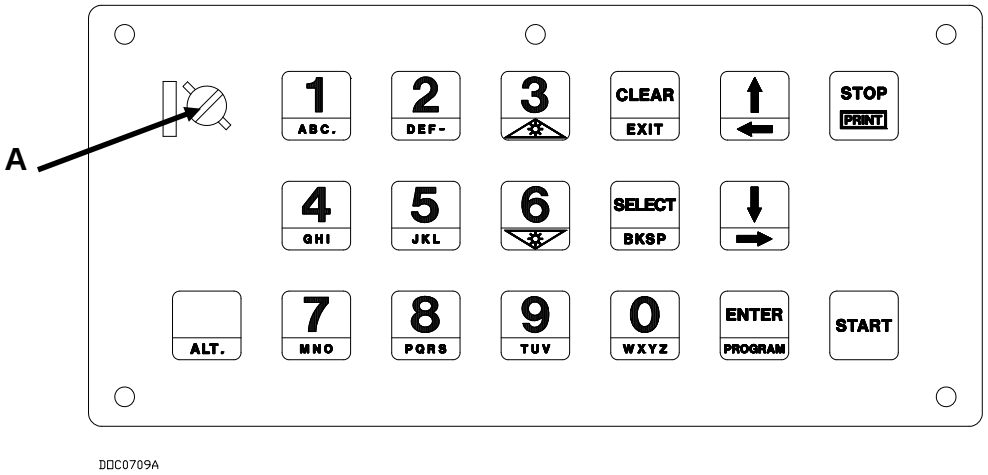
C: Keypad

Figure 2-9. DL8000 Operator Interface

Component	Use
Keypad	Enables the operator to select recipes, enter the desired quantity, and control batch deliveries. **Note**: With appropriate authority, the operator can also program the DL8000.
Display	A liquid crystal display (LCD) panel divided into two sections (right and left). Each section provides eight lines of up to 40 characters in width. The display and keypad provide the primary method for operating the DL8000.
LED Status Indicators	Three light-emitting diodes (LEDs) display through the vertical window to the right of the LCD, indicating the DL8000's operational status.

2.8.1 Keypad

The DL8000 keypad enables the operator to select recipes, enter the desired preset quantity, control batch deliveries, and (with appropriate authority) program the DL8000. See *Figure 2-10*.



A: Weights & Measures Switch

Figure 2-10. DL8000 Keypad

Key	Function
0 through 9	Provide numeric digits for data entry. ALT+3 increases the brightness of the display; ALT+6 decreases the brightness of the display. **Note**: The alphabetic values on the numeric keys are currently not supported.
ENTER/PROGRAM	Accept the manually entered value and continue. **Note**: The ALT+PROGRAM function is not currently supported.
CLEAR/EXIT	Reject the manually entered value and continue. ALT+EXIT leaves the display.
SELECT/BKSP	Toggle the On/Off option for each defined additive. ALT+BKSP (Backspace) moves the cursor position back one character at a time.
↓/→	Scroll down or move the select box to the next item in the Recipes Selection display. ALT+→ moves to the next display.
↑/←	Scroll up or move the select box to the previous item in the Recipes Selection display. ALT+← moves to the next display.
START	Initiate the batch loading operation after batch setup data has been entered.
STOP/PRINT	Stop the batch loading operation. **Note**: The ALT+PRINT function is not currently supported.
ALT	Enable alternative functions on selected keys.

Note: The Weights & Measures switch, located in the left upper corner of the keypad, is lockable and wire-sealable to restrict access to the flow calculations.

2.8.2 LED Status Indicators

The yellow, red, and green LEDs (see *Figure 2-9*) provide information about the DL8000's operational status.

LED	Mode	Status	Function
YELLOW	Manual	Off	DL8000 is operating in Manual mode. **Note**: Local operation is identical in either Manual or Auto mode.
	Auto	On	DL8000 is operating in Auto mode (linked to a host computer and operating as a slave unit.
		Flashing	▪ **Two short pulses each second**: case internal temperature is too high, the keypad/display is disconnected, or power is removed from the keypad/display. ▪ **One short pulse every two seconds**: Condition that caused the alarm has returned to normal. Power up the DL8000 or reset to continue using the keypad/display. ▪ **Rapid flashing:** Power failure or low power situation.
GREEN	Permissive Power	On	The permissive power circuit is closed (the normal state when a batch delivery is in progress). **Note**: The green LED indicator's function depends on the state of the permissive circuit (which is located in the power supply) and is not programmable.
		Off	The permissive power circuit is open. This indicates an abnormal state which is due to permissive power failure or failure of one or more permissive circuits wired in series (wired AND) with the permissive power source **Note**: The green LED indicator's function depends on the state of the permissive circuit (which is located in the power supply) and is not programmable.
RED	Alarm Status	On	A primary (or critical) alarm is active. You **must** clear this alarm before you can begin a new batch or new transaction.
		Off	All alarms are inactive.
		Flashing	A secondary (non-critical) alarm is active.

Chapter 3 – Modules

This chapter describes the various power, input/output, and communications modules the DL8000 uses. It also describes how to install, remove, and wire the modules.

In This Chapter

3.1 Power Input Module 3-1
3.1.1 12 Volt DC Power Input Module 3-2
3.2 Input/Output Modules 3-3
3.2.1 General Installation 3-5
3.2.2 Installing an I/O Module 3-6
3.2.3 Removing an I/O Module 3-6
3.2.4 Wiring I/O Modules 3-7
3.2.5 Analog Input (AI) Modules 3-7
3.2.6 Analog Output (AO) Modules 3-9
3.2.7 Discrete Input (DI) Modules 3-10
3.2.8 Pulse Input (PI) Modules 3-12
3.2.9 Discrete Output (DO) Modules 3-14
3.2.10 Discrete Output Relay (DOR) Modules 3-15
3.2.11 Resistance Temperature Detector (RTD) Input Modules 3-17
3.2.12 Alternating Current Input/Output (AC I/O) Module 3-18
3.2.13 Advance Pulse Module (APM) 3-23
3.2.14 Thermocouple (TC) Input Module 3-27
3.2.15 HART® Module 3-30
3.3 Communication Modules and Ports 3-32
3.3.1 Wiring Communications 3-34
3.3.2 Local Operator Interface (LOI – Local Port) 3-35
3.3.3 Using the LOI 3-36
3.3.4 Ethernet Communications 3-36
3.3.5 EIA-232 (RS-232) Serial Communications 3-38
3.3.6 EIA-422/485 (RS-422/485) Serial Communications Module 3-39
3.3.7 EIA-422/485 (RS-422/485) Jumpers & Termination Resistors 3-40
3.3.8 Dial-up Modem Communications Module 3-41
3.4 Additional Technical Information 3-43

3.1 Power Input Module

The DL8000 uses a Power Input module to convert the voltage from the AC power supply to the voltage levels the DL8000 unit's electronics require and to monitor voltage levels to ensure proper operation. All DL8000 applications use the 12 volt Power Input module.

The Power Input module has removable terminal blocks for wiring and servicing. The terminal blocks can accept wire sizes between 12 and 22 AWG (American Wire Gauge).

3.1.1 12 Volt DC Power Input Module

The DL8000 accepts 12 Volts dc (nominal) input power from an internally mounted AC/DC converter. The 12 volt DC output from the AC/DC converter is connected to the BAT+ and BAT– terminals. The base system (CPU, power input, and backplane) requires less than 70 mA. The Power Input module economizes power consumption using 3.3 Volts dc switching power that provides power to the DL8000 modules via the backplane. The DL8000 requires 11.25 to 14.25 Volts dc for proper operation.

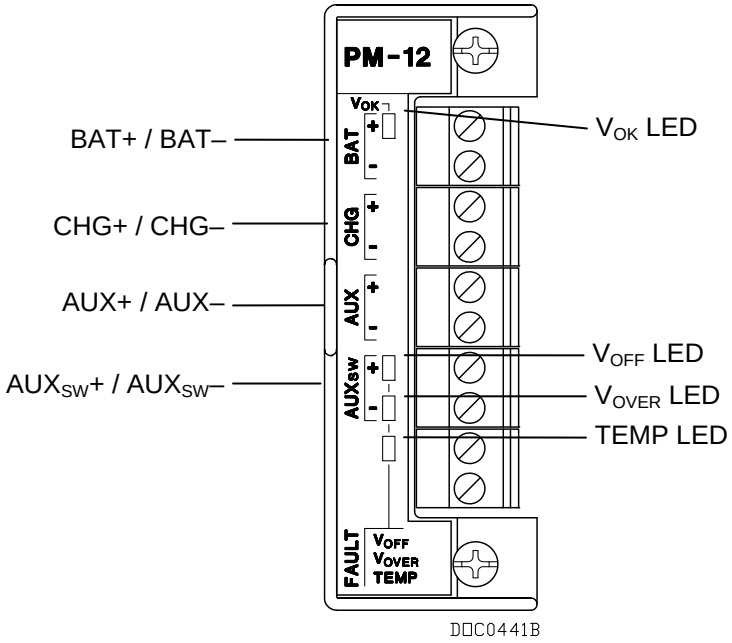


Figure 3-1. 12 Volt DC Power Input Module

The CHG+ and CHG– terminals comprise an Analog Input channel that allows you to monitor a voltage, such as an external charging source from a solar panel. These inputs are not normally used for the DL8000.

The AUX+ / AUX – terminals can be used to supply reverse-polarity-protected source voltage to external devices, such as a radio or solenoid. The AUXSW+ / AUXSW– terminals can be used to provide switched power for external devices. The AUXSW+ is turned off when a software configurable voltage is detected at the BAT+ / BAT– terminals.

Table 3-1 details the specific connection information for the 12 Volt dc (PM-12) Power Input module. *Table 3-2* details the LED fault indicators.

Table 3-1. 12 Volt DC Power Input Terminal Block Connections

Terminal Blocks	Definition	Volts DC
BAT+ and BAT–	Accepts 12 Volts dc nominal from an AC/DC converter or other 12 Volt dc supply.	Absolute Maximum: 11.25 to 16 Volts dc Recommended Operating Range: 11.25 to 14.25 Volts dc
CHG+ and CHG–	Analog Input used to monitor an external charging source.	0 to 18 Volts dc
AUX+ and AUX–	Supplies reverse-polarity-protected source voltage to external devices.	BAT+ minus ~0.7 Volts dc
AUX_{SW}+ and AUX_{SW}–	Supplies switched power for external devices.	0 to 14.25 Volts dc

Table 3-2. 12 Volt DC Power Input LED Fault Indicators

Signal	LED
V_{OK}	Green LED on when voltage is in tolerance on BAT+ and BAT–.
V_{OFF}	Fault – Red LED on when the AUX_{SW}+ output are disabled by the CPU control line.
V_{OVER}	Fault – Red LED on when AUX_{SW}+ is disabled due to excess voltage on BAT+.
TEMP	Fault – Red LED on when AUX_{SW}+ output are disabled due to the excess temperature of the Power Input module.

3.2 Input/Output Modules

The I/O modules typically consist of a terminal block for field wiring and connectors to the backplane. The DL8000 supports up to nine I/O modules, and can accommodate a wide range of process inputs and outputs. Each I/O module electrically connects to field wiring by a removable terminal block. Refer to *Figures 3-2* and *3-3*.

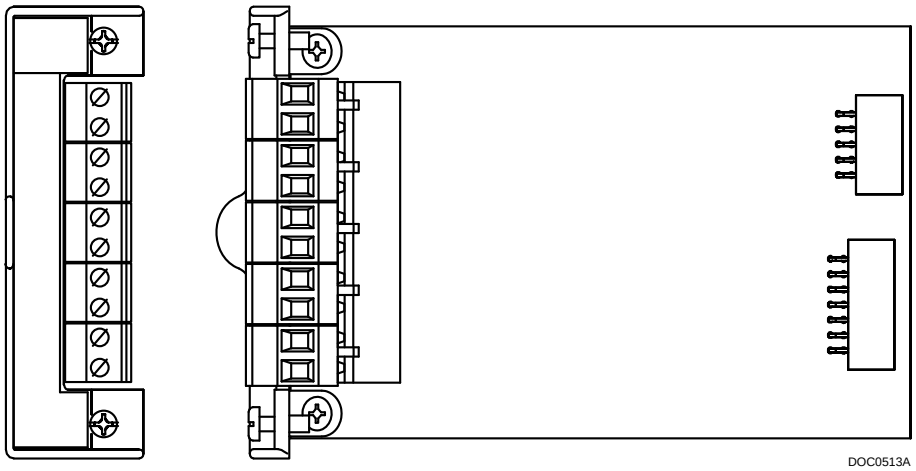


Figure 3-2. Typical I/O Module

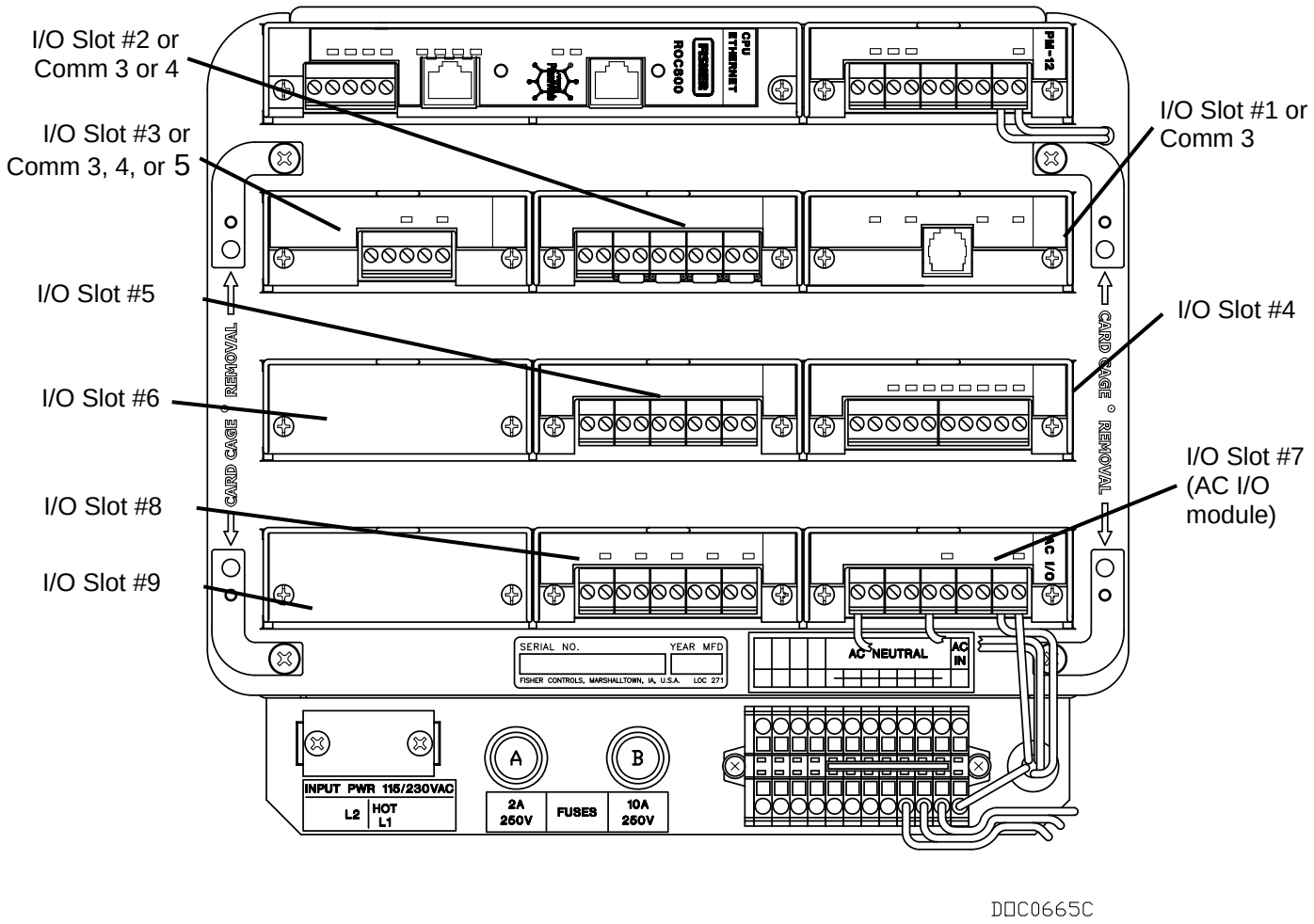


Figure 3-3. Optional I/O Module Locations

Available I/O modules for the DL8000 include:

- Analog Input (AI) modules that provide the ability to monitor various analog field values.
- Discrete Input (DI) (for DC) and Pulse Input (PI) modules that provide the ability to monitor various discrete and pulse input field values.
- Analog Output (AO), Discrete Output (DO), and Discrete Output Relay (DOR) modules that provide the ability to control various control devices.
- The Alternating Current I/O Module (AC I/O) module provides the ability to read the status of an AC input or control an AC output.
- The Advance Pulse Module (APM) provides advanced functionality typically found in liquids and gas measurement applications.
- The RTD Input module provides the ability to monitor various analog temperature field values.

- The HART® interface module that enables the DL8000 to communicate with devices using the Highway Addressable Remote Transducer (HART) protocol as either Analog Inputs or Analog Outputs.

Each module rests in a module slot at the front of the DL8000 housing. I/O modules easily install into and remove from the module slots. You can install and remove modules while the DL8000 is powered up (hot-swappable). Modules may be installed directly into unused module slots (hot-pluggable), and modules are self-identifying in the software. All modules have removable terminal blocks to make servicing easy. I/O modules can be added in any module slot.

Note: You can install comm modules only in slots 1, 2, or 3 of the DL8000.

The I/O modules acquire power from the backplane. Each module has an isolated DC/DC converter that provides logic, control, and field power as required. The DL8000 has eliminated the need for fuses on the I/O modules through the extensive use of current-limited short-circuit protection and over voltage circuitry. Isolation is provided from other modules and the backplane, power, and signal isolation. The I/O modules are self-resetting after a fault clears.

3.2.1 General Installation

Each I/O module installs in the DL8000 in the same manner. You can install any I/O module into any module socket, whether empty or in place of another module.

⚠ Caution

Failure to exercise proper electrostatic discharge precautions (such as wearing a grounded wrist strap) may reset the processor or damage electronic components, resulting in interrupted operations.

When installing units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

You can insert or remove the I/O modules while power is connected to the DL8000. If the DL8000 is powered, exercise caution while performing the following steps to install a module.

Note: After you install a new I/O module or replace an existing I/O module, it may be necessary to reconfigure the DL8000. To change configuration parameters, use ROCLINK 800 software to make changes to the new module. Any added modules (new I/O points) start up with default configurations. Refer to the *ROCLINK 800 Configuration Software User Manual* (Form A6121).

3.2.2 Installing an I/O Module

To install an I/O module:

1. Remove the wire channel cover.

   Note: Leaving the wire channel cover in place can prevent the module from correctly connecting to the socket on the backplane.

2. Perform one of the following:
   - If there was previously a module in the slot, unscrew the captive screws and remove that module.
   - If the slot was previously unused, remove the module cover.
3. Insert the new I/O module into the module slot in the card cage. Make sure the label on the front of the module is facing right side up. Gently slide the module in place until it contacts the connectors on the backplane.

   Note: If the module stops and will not go any further, do not force the module. Remove the module and see if the pins are bent. If so, gently straighten the pin(s) and re-insert the module. The back of the module must connect fully with the connectors on the backplane.

4. Tighten the captive screws on the front of the module.
5. Wire the I/O module (refer to *Section 3.2.4, Wiring I/O Modules*).
6. Replace the wire channel cover.

⚠ Caution **Never connect the sheath surrounding shielded wiring to a signal ground terminal or to the common terminal of an I/O module. Doing so makes the I/O module susceptible to static discharge, which can permanently damage the module. Connect the shielded wiring only to a suitable earth ground.**

7. Connect to ROCLINK 800 software and login. The I/O modules are self-identifying after re-connecting to ROCLINK 800 software.
8. Configure the I/O point.

3.2.3 Removing an I/O Module

To remove an I/O module:

1. Remove the wire channel cover.
2. Unscrew the two captive screws holding the module in place.
3. Gently pull the module's lip out and remove the module from the slot. You may need to gently wiggle the module.

4. Install a new module or install the module cover.
5. Screw the two captive screws to hold the module or cover in place.
6. Replace the wire channel cover.

3.2.4 Wiring I/O Modules

All modules have removable terminal blocks for convenient wiring and servicing. The terminal blocks accommodate wire sizes between 12 and 22 AWG.

Caution **Failure to exercise proper electrostatic discharge precautions (such as wearing a grounded wrist strap) may reset the processor or damage electronic components, resulting in interrupted operations.**

To connect the wire to the removable block compression terminals:

1. Bare the end (¼ inch or 6.3mm maximum) of the wire.
2. Insert the bared end into the clamp beneath the termination screw.
3. Tighten the screw.

Expose a minimum of bare wire to prevent short circuits. Allow some slack when making connections to prevent strain.

Note: All modules have removable terminal blocks for convenient wiring and servicing. Twisted-pair cable is recommended for I/O signal wiring. The removable terminal blocks accept wire sizes between 12 and 22 AWG.

3.2.5 Analog Input (AI) Modules

The Analog Input (AI) modules (AI-12 and AI-16) have four scalable channels, which typically measure either:

- 4 to 20 mA analog signal, with the use of a precision resistor (supplied).
- 1 to 5 Volts dc signal.

If required, you can calibrate the low end of the analog signal to zero (refer to *Chapter 7* in the *ROCLINK 800 Configuration Software User Manual*, Form A6121).

Note: The AI-16 module provides 16-bit resolution and uses a 24-bit A/D converter. DIP switches on the AI-16 control the scaling (see *Figure 3-6*).

You can configure the AI (+T) as either 12 or 24 Volts dc using jumper J4 on the AI-12 module (see *Figure 3-4*). The AI modules can provide isolated +12 Volts dc or +24 Volts dc field transmitter power on a per module basis. For example, one module can provide +12 Volts dc for

powering low-power analog transmitters, while another module in the same DL8000 controller can provide +24 Volts dc for powering conventional 4 to 20 mA transmitters. See *Figure 3-5*.

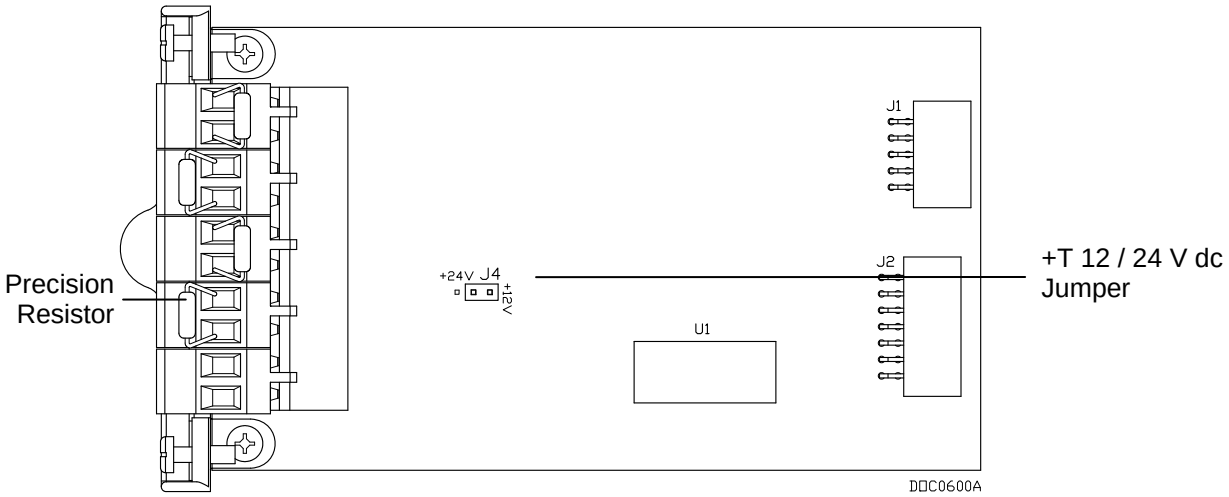


Figure 3-4. AI-12 Jumper J4 (Shown Set to +12V)

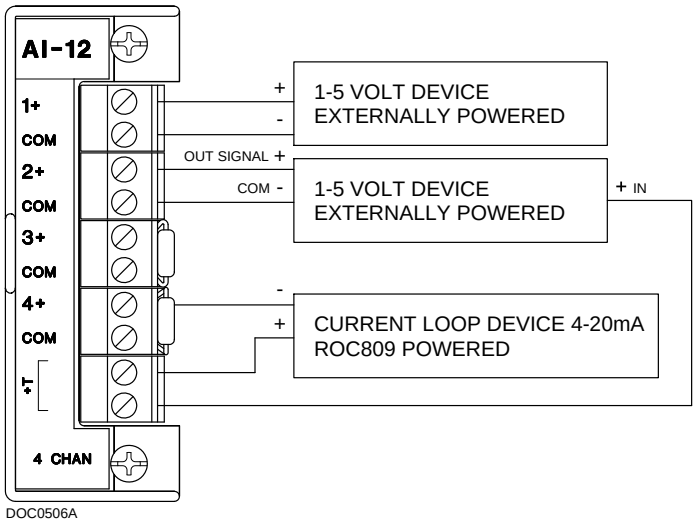


Figure 3-5. Analog Input Module Field Wiring

On the AI-16 module, you use jumper J3 to configure the AI (+T) as 12 or 24 Volts dc. Additionally, two DIP switches provide scaling control (see *Figure 3-6*).

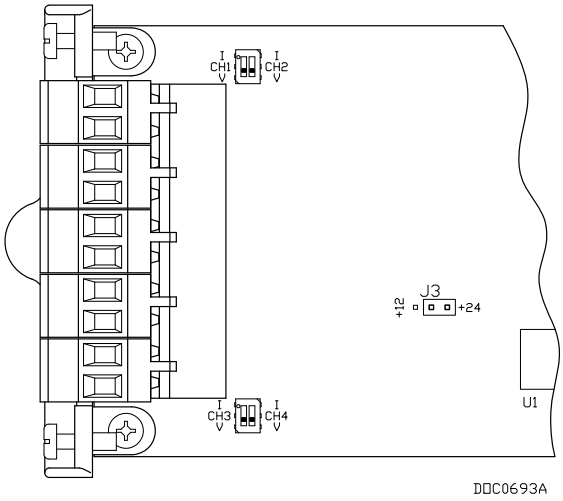


Figure 3-6. AI-16 DIP Switches

Caution **You can induce ground loops by tying commons from various modules together.**

3.2.6 Analog Output (AO) Modules

The 16-bit Analog Output (AO) module has four channels that provide a current output for powering analog devices. Analog outputs are analog signals the DL8000 controller generates to regulate equipment, such as control valves or any device requiring analog control.

Each channel on this module provides a 4 to 20 mA current signal for controlling analog current loop devices. The AO module isolation includes the power supply connections.

Note: AO modules (Part Number W38199) with front labels that read *AO-16* are an earlier version that controls the low side current. AO modules (Part Number W38269) with front labels that read *AO* are the newer version (January 2005 and later) and control the high side current.

You can configure the AO module as 12 or 24 Volts dc via jumper J4 on the I/O module (see *Figure 3-7*). The AO module can provide isolated +12 Volts dc or +24 Volts dc field transmitter power on a per module basis. For example, one module can provide +12 Volts dc for powering low power analog transmitters, while another module in the same DL8000 controller can provide +24 Volts dc for powering conventional 4 to 20 mA transmitters. See *Figure 3-7*.

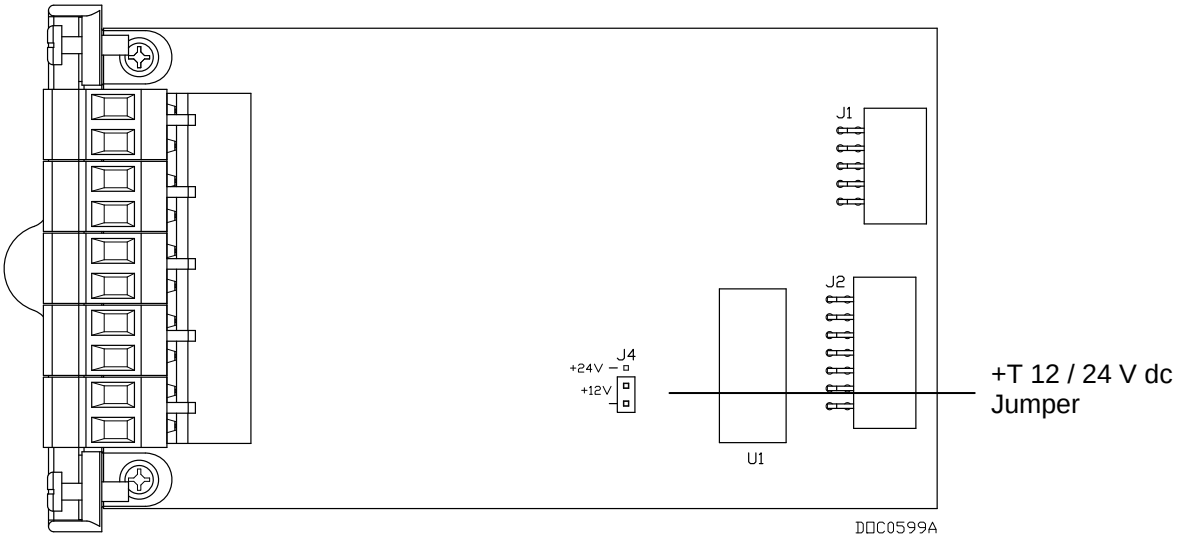


Figure 3-7. Analog Output Jumper J4 (Shown Set to +12V)

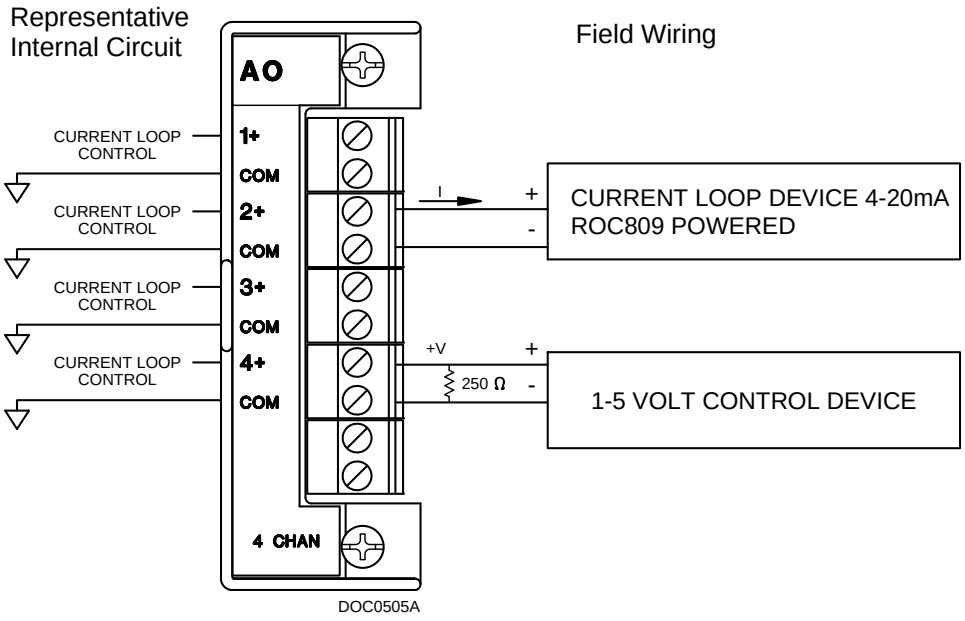


Figure 3-8. Analog Output Module Field Wiring

⚠ Caution **You can induce ground loops by tying commons from various modules together.**

3.2.7 Discrete Input (DI) Modules

The eight-channel Discrete Input (DI) modules monitor the status of relays, open collector/open drain type solid-state switches, and other two-state devices. Discrete Inputs come from relays, switches, and other devices, which generate an on/off, open/close, or high/low signal.

The DI module provides a source voltage for dry relay contacts or for an open-collector solid-state switch.

The DI module's LEDs light when each input is active.

You can configure each DI channel to function as a momentary or latched DI (see the *ROCLINK 800 Configuration Software User Manual*, Form A6121). A latched DI remains in the active state until reset. Other parameters can invert the field signal and gather statistical information on the number of transitions and the time accumulated in the on-state or off-state.

Caution **The Discrete Input module operates with non-powered discrete devices, such as "dry" relay contacts or isolated solid-state switches. Use of the DI module with powered devices may cause improper operation or damage.**

The DI module senses the current flow, which signals the electronics in the DL8000 that the relay contacts have closed. When the contacts open, current flow interrupts, and the DI module signals the electronics in the DL8000 that the relay contacts have opened. A DL8000 can read a DI a maximum of 250 times per second.

The left side of *Figure 3-9* displays the internal circuitry while the right side of the diagram displays possible field wiring.

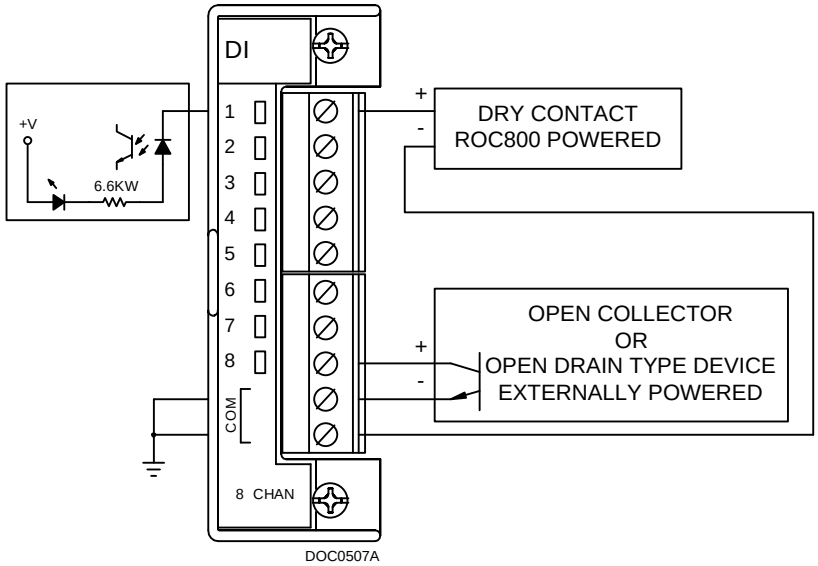


Figure 3-9. Discrete Input Module Field Wiring

Caution **You can induce ground loops by tying commons from various modules together.**

3.2.8 Pulse Input (PI) Modules

The Pulse Input (PI) module provides two channels for measuring either a low speed or high speed pulse signal. The PI module processes signals from pulse-generating devices and provides a calculated rate or an accumulated total over a configured period. Functions supported are slow-counter input, slow rate input, fast counter input, and fast rate input.

The PI is most commonly used to interface to relays or open collector/open drain type solid-state devices. The Pulse Input can be used to interface to either self-powered or DL8000-powered devices.

The high speed input supports signals up to 12 KHz while the low speed input is used on signals less than 125 Hz.

You can configure the PI module as either 12 or 24 Volts dc using jumper J4 on the module (see *Figure 3-10*). The PI modules can provide isolated +12 Volts dc or +24 Volts dc field transmitter power on a per module basis. For example, one module can provide +12 Volts dc power, while another module in the same DL8000 controller can provide +24 Volts dc power. See *Figures 3-11* and *3-12*.

The PI module provides LEDs that light when each input is active.

⚠ Caution **The Pulse Input module only operates with non-powered devices, such as "dry" relay contacts or isolated solid-state switches. Use of the PI module with powered devices may cause improper operation or damage.**

The PI modules draw power for the active circuitry from the backplane. Input signals are optically isolated.

Note: Do not connect wiring to both the Low and High speed selections for a given channel. Unpredictable operation of the PI module will result.

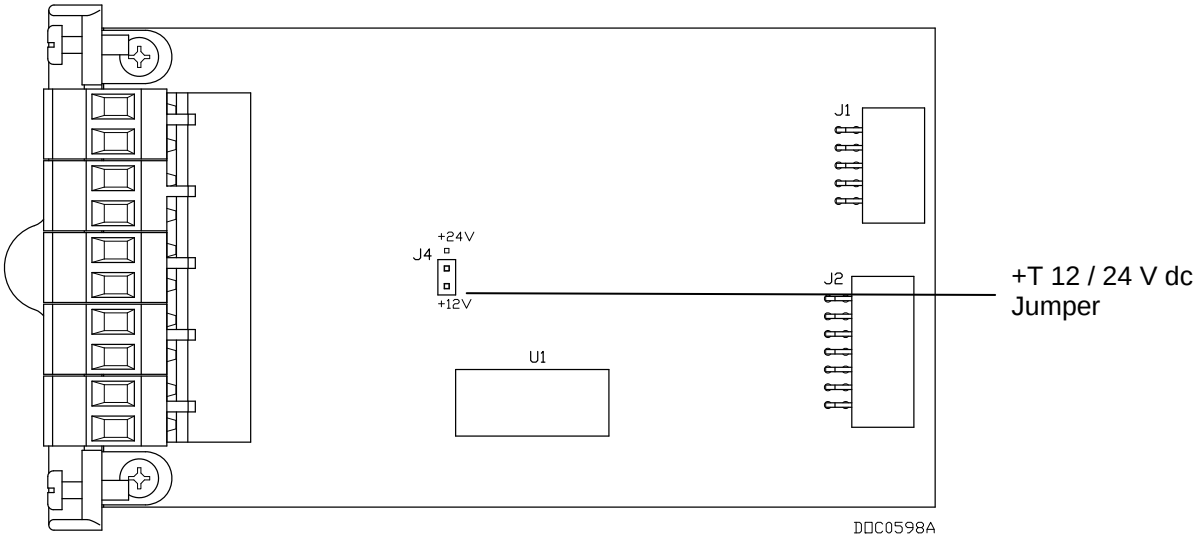


Figure 3-10. Pulse Input J4 Jumper (Set to +12 V)

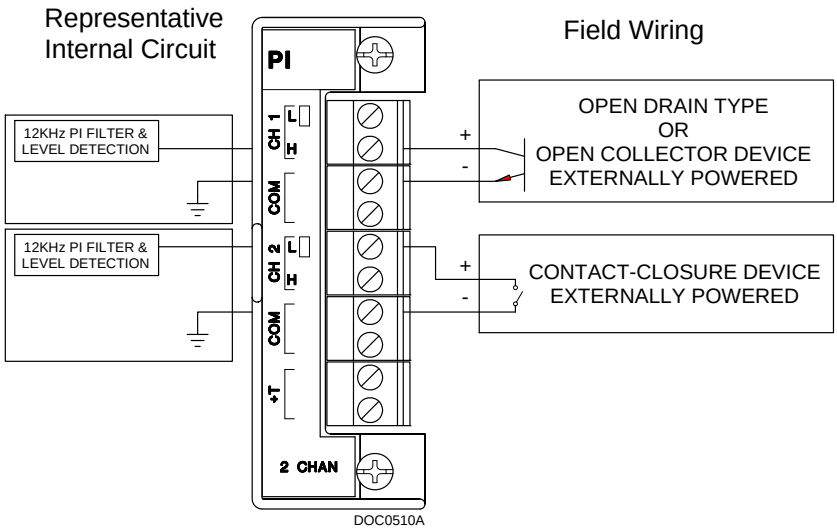


Figure 3-11. Externally Powered Pulse Input Module Field Wiring

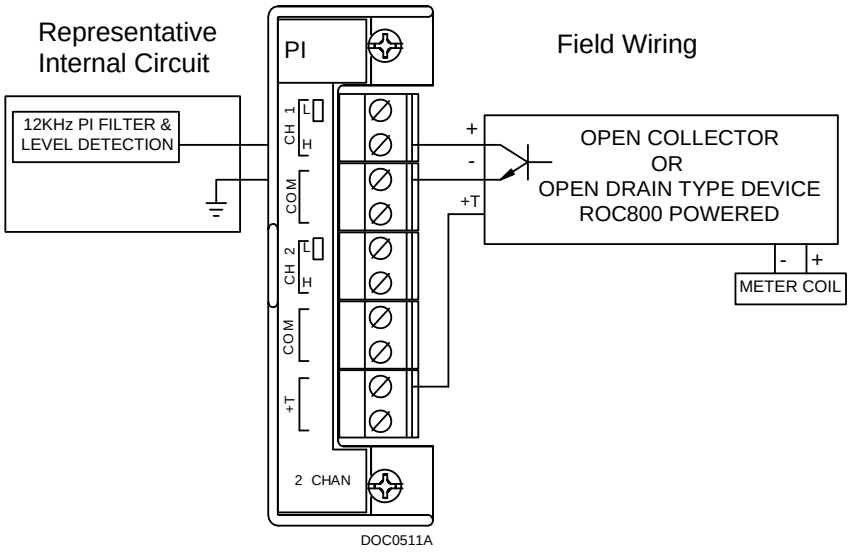


Figure 3-12. DL8000 Powered Pulse Input Module Field Wiring

Caution **You can induce ground loops by tying commons from various modules together.**

3.2.9 Discrete Output (DO) Modules

The five-channel Discrete Output (DO) module provides two-state outputs to energize solid-state relays and power small electrical loads. These are solid-state relays. A Discrete Output may be set to send a pulse to a specified device. Discrete Outputs are high/low outputs used to turn equipment on/off. The DO module provides LEDs that light when each output is active.

You can configure DO modules as latched, toggled, momentary, or Timed Duration Outputs (TDO). You can also configure the DO to either retain the last value on reset or use a user-specified fail-safe value. Refer to the *ROCLINK 800 Configuration Software User Manual*, Form A6121.

When a request is made to change the state of a DO, the request is immediately sent to the DO module. There is no scan time associated with a DO. Under normal operating conditions, the DO channel registers the change within 2 milliseconds. If the DO is in momentary or toggle mode, the minimum time on that can be entered is 4 milliseconds.

Figure 3-13 displays the field wiring connections to the output circuit of the DO module.

Caution **The Discrete Output module only operates with non-powered discrete devices, such as relay coils or solid-state switch inputs. Using the module with powered devices may cause improper operation or damage.**

The DO modules draw power for the active circuitry from the backplane. The DO module is current-limited for protection against excessive current.

Note: When using a DO module to drive an inductive load (such as a relay coil), place a suppression diode across the input terminals to the load. This protects the module from the reverse Electro-Motive Force (EMF) spike generated when the inductive load is switched off.

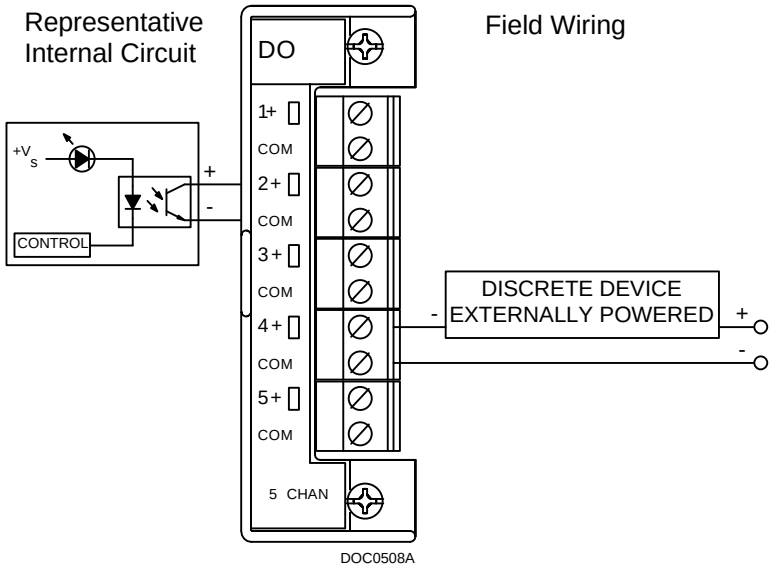


Figure 3-13. Discrete Output Module Field Wiring

Caution **You can induce ground loops by tying commons from various modules together.**

3.2.10 Discrete Output Relay (DOR) Modules

The five-channel DO Relay (DOR) module provides LEDs that light when each output is active. DOR modules use dual-state latching relays to provide a set of normally open, dry contacts capable of switching 2 A at 32 Volts dc across the complete operating temperature. Using ROCLINK 800, you can configure the module as latched, toggled, momentary, or Timed Duration Outputs (TDO). You can configure the DOR either to retain the last value on reset or to use a user-specified fail-safe value.

Figure 3-14 displays the field wiring connections to the output circuit of the DO Relay module.

Note: The Discrete Output Relay module operates only with discrete devices having their own power source.

When a request is made to change the state of a DOR, the request is immediately sent to the DOR module. There is no scan time associated with a DOR. Under normal operating conditions, the DOR channel registers the change within 12 milliseconds. If the DOR is in momentary or toggle mode, DOR channels register the change within 48 milliseconds.

The DOR modules draw power for the active circuitry from the backplane.

Note: On power up or reset, the DO Relay module's LEDs enter indeterminate state for a few seconds as the module self-identifies. The LEDs may flash, stay on, or stay off for a few seconds.

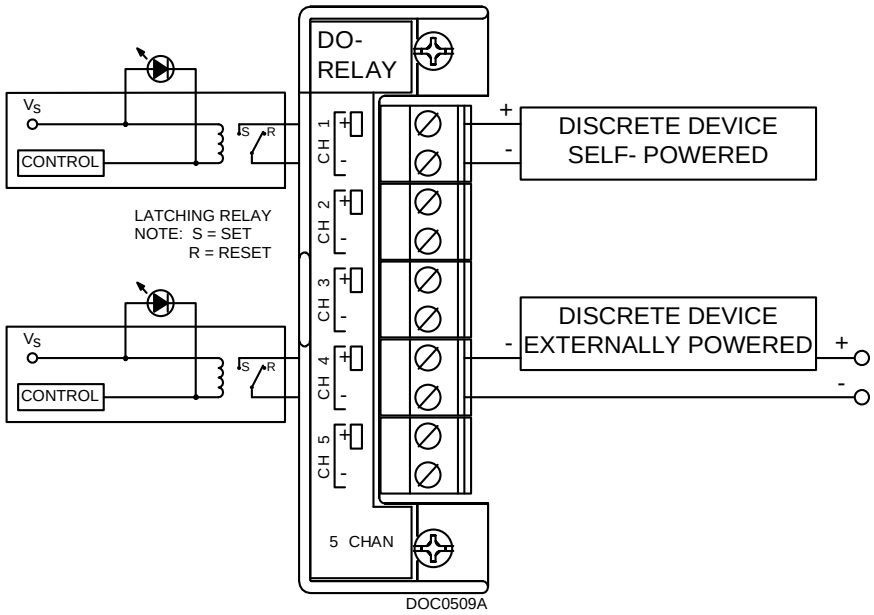


Figure 3-14. Discrete Output Relay Module Field Wiring

⚠ Caution **You can induce ground loops by tying commons from various modules together.**

3.2.11 Resistance Temperature Detector (RTD) Input Modules

The Resistance Temperature Detector (RTD) module monitors the temperature signal from an RTD source. The module can accommodate input from a two-, three-, or four-wire RTD source.

The active element of an RTD probe is a precision, temperature-dependent resistor, made from a platinum alloy. The resistor has a predictable positive temperature coefficient, meaning its resistance increases with temperature. The RTD input module works by supplying a small consistent current to the RTD probe and measuring the voltage drop across it. Based on the voltage curve of the RTD, the signal is converted to temperature by the DL8000 firmware.

The RTD input module monitors the temperature signal from a Resistance Temperature Detector (RTD) sensor or probe. A 2-channel 16-bit RTD module is available. The RTD module isolation includes the power supply connections.

The RTD modules draw power for the active circuitry from lines on the backplane.

It may be more convenient to perform calibration before connecting the field wiring. However, if the field wiring between the DL8000 and the RTD probe is long enough to add a significant resistance, then perform calibration in a manner that considers this.

Connecting the RTD Wiring

Temperature can be input through the Resistance Temperature Detector (RTD) probe and circuitry. An RTD temperature probe mounts directly to the piping using a thermowell. Protect RTD wires either by a metal sheath or by conduit connected to a liquid-tight conduit fitting. The RTD wires connect to the four screw terminals designated “RTD” on the RTD module.

The DL8000 controller provides terminations for a four-wire 100-ohm platinum RTD with a DIN 43760 curve. The RTD has an alpha equal to 0.00385 or 0.00392 Ω/Ω/°C. A two-wire or three-wire RTD probe can be used instead of a four-wire probe; however, they may produce measurement errors due to signal loss on the wiring. See *Figure 3-15.*

Wiring between the RTD probe and the DL8000 must be shielded wire, with the shield grounded only at one end to prevent ground loops. Ground loops cause RTD input signal errors.

Table 3-3. RTD Signal Routing

Signal	Terminal	Designation
CH 1 (REF)	1	Constant Current +
CH 1 (+)	2	V+ RTD
CH 1 (–)	3	V– RTD
CH 1 (RET)	4	Constant Current –
Not Connected	5	N/A
CH 2 (REF)	6	Constant Current +

Signal	Terminal	Designation
CH 2 (+)	7	V+ RTD
CH 2 (–)	8	V– RTD
CH 2 (RET)	9	Constant Current –
Not Connected	10	N/A

⚠ Caution **You can induce ground loops by tying commons from various modules together.**

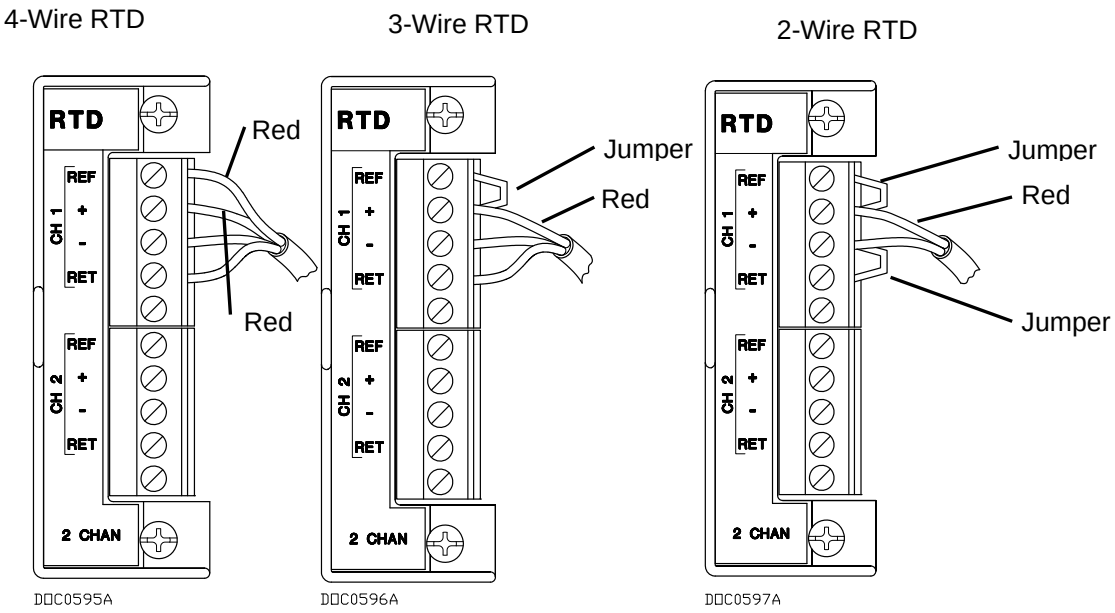


Figure 3-15. RTD Sensor Wiring Terminal Connections

Table 3-4. RTD Wiring

Terminal	4-Wire RTD	3-Wire RTD	2-Wire RTD
REF	Red	Jumper to +	Jumper to +
+	Red	Red, Jumper to REF	Red, Jumper to REF
–	White	White	White, Jumper to RET
RET	White	White	Jumper to –

Note: The wire colors for the RTD being used may differ.

3.2.12 Alternating Current Input/Output (AC I/O) Module

⚠ Warning **EMC issues restrict the use of the AC I/O module only to devices using a PM-12 power module. You CANNOT use the AC I/O module in a device that uses a PM-24 power module.**

Switchable I/O and LEDs

The module has one bank of six DIP switches on its daughterboard (see *Figure 3-16*), which controls the input/output status of each of the six channels. Placing a switch in the ON position sets the

corresponding channel to output mode. Placing a switch in the OFF position sets the channel to input mode. Dual-color light-emitting diodes (LEDs) indicate the current status for each channel. Red means AC source is being output. Green means the module has detected AC on an input channel.

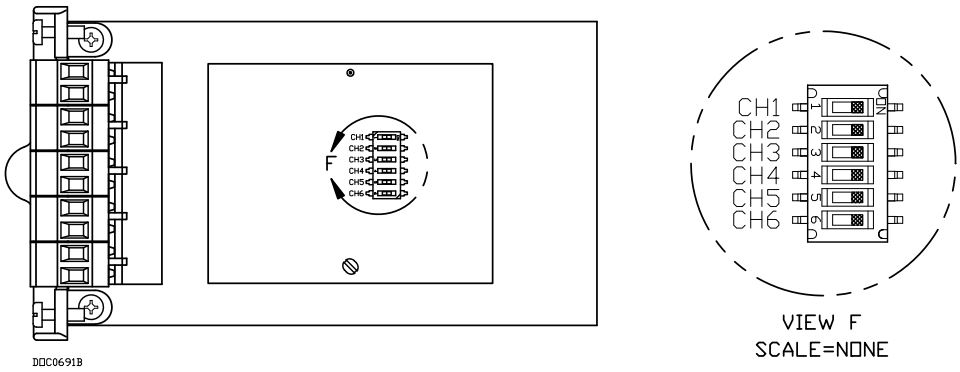


Figure 3-16. AC I/O DIP Switches

AC Discrete Outputs

In output mode, the module provides up to six channels for switching discrete AC. Each channel uses a solid-state normally open relay rated at 1.5 Amps. Any AC switched out is directly related to the AC switched in. Using ROCLINK 800, you can configure the module as latched, toggled, momentary, or Timed Duration Outputs (TDOs). Other parameters report the approximate load, over-current conditions, and AC input status. Discrete outputs can be configured to either retain the last value on reset or a user-specified fail-safe value. See *Figure 3-17*.

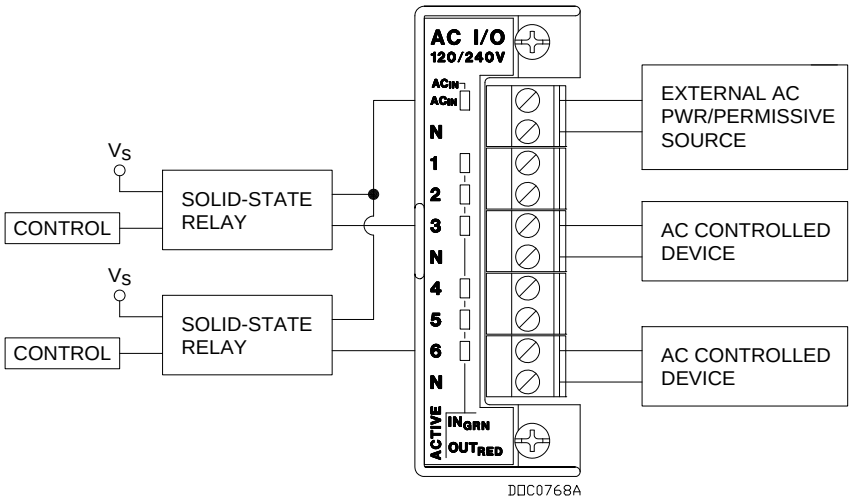


Figure 3-17. AC I/O Module (Output Field Wiring)

Note: If the label on your AC I/O module **does not** indicate 120/240V, your module is designed for use **only** with 120V. Additionally, all AC wiring must be shielded.

AC Discrete Inputs

You can configure each channel as an AC input/detector. Each channel can detect the presence of an AC signal between 90 and 265 Vrms at 47 to 63 Hz. In discrete input mode the module monitors the status of various AC sources.

You can also software-configure each channel to function as a latched DI, which remains in active state until reset. Other parameters can invert the field signal and gather statistical information on the number of transitions and the time accumulated in the on or off state. The fastest time that each channel within the module can be read is 20 times per second. See *Figure 3-18.*

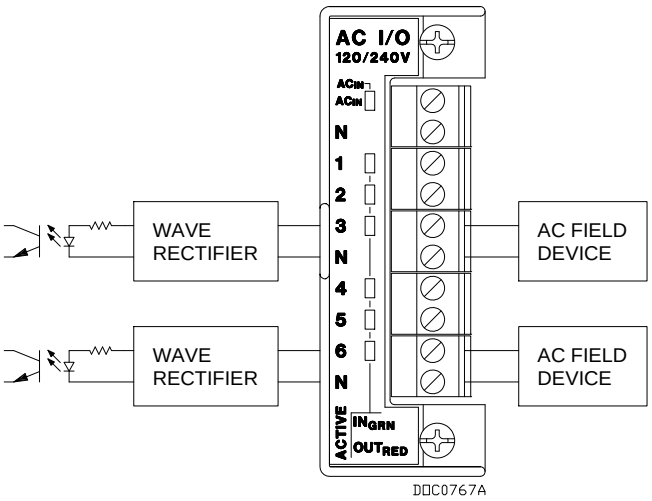


Figure 3-18. AC I/O Module (Input Field Wiring)

Note: If the label on your AC I/O module **does not** indicate 120/240V, your module is designed for use **only** with 120V. Additionally, all AC wiring must be shielded.

Table 3-5. Field Wiring Terminals

Terminal	Label	Definition
1	AC In	AC Input (Permissive Power)
2	N	AC Neutral
3	1	Channel 1
4	2	Channel 2
5	3	Channel 3
6	N	AC Neutral
7	4	Channel 4
8	5	Channel 5

Terminal	Label	Definition
9	6	Channel 6
10	N	AC Neutral

The field terminal wiring has the following definitions:

Term	Definition
AC Input	The AC power applied to this terminal is the source for any channel that is configured as an output. The input to this terminal should be externally fused with a 10 to 15 amp fuse. The channel has a green LED associated with it to indicate when power is applied. This terminal is typically wired to the permissive/safety circuitry so that if this circuit trips, all power is removed from the channels that are configured as AC outputs.
AC Neutral	This terminal is connected to the system AC neutral and is used a reference for all AC power.
Channels 1 through 6	Depending upon the configuration of the DIP switch, each channel can be configured as an input or an output.

Multiple AC I/O Modules

If you need to install more than one AC I/O module in the DL8000, wire the modules as shown in *Figures 3-19* and *3-20*.

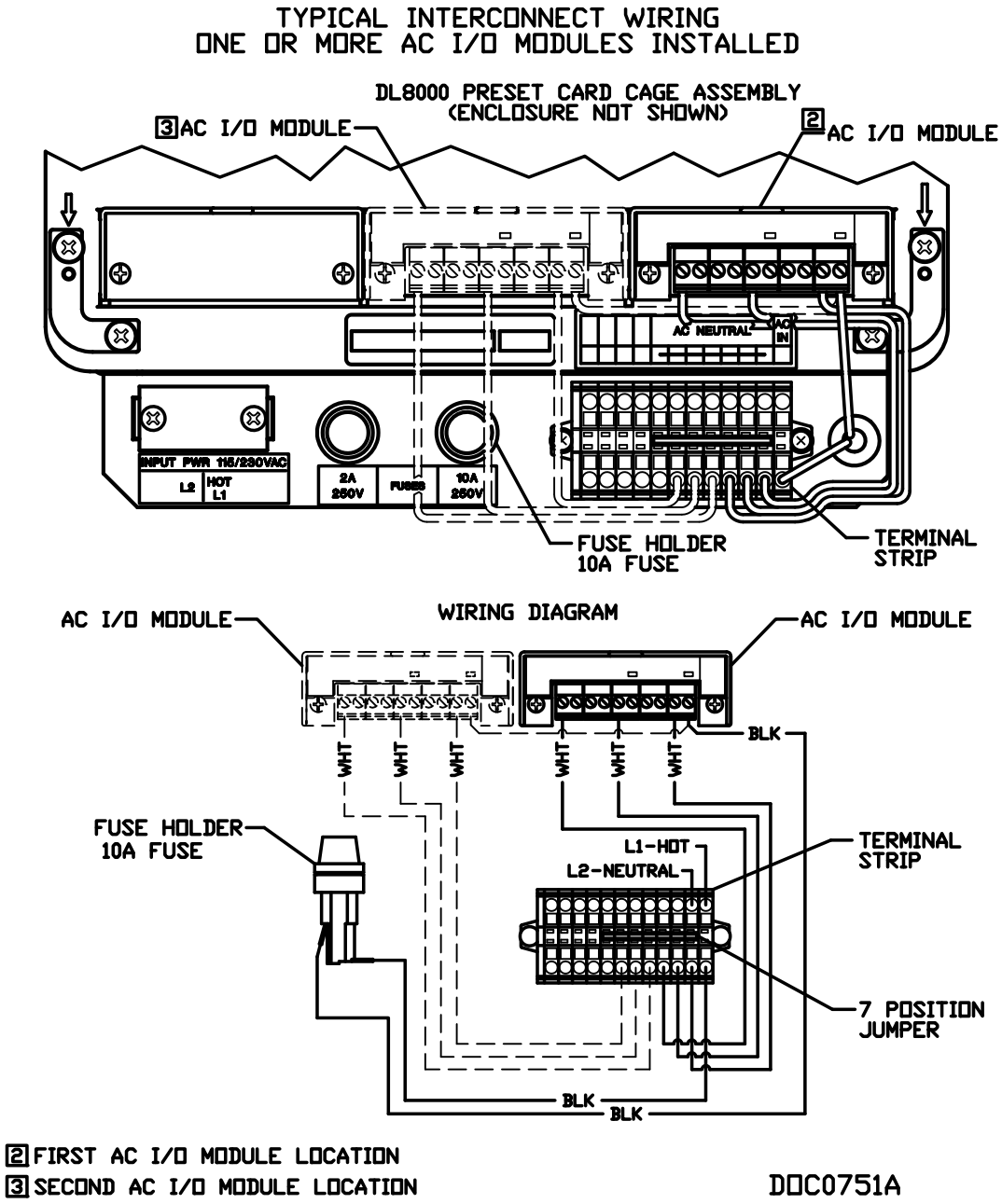


Figure 3-19. Wiring with Multiple AC I/O Modules

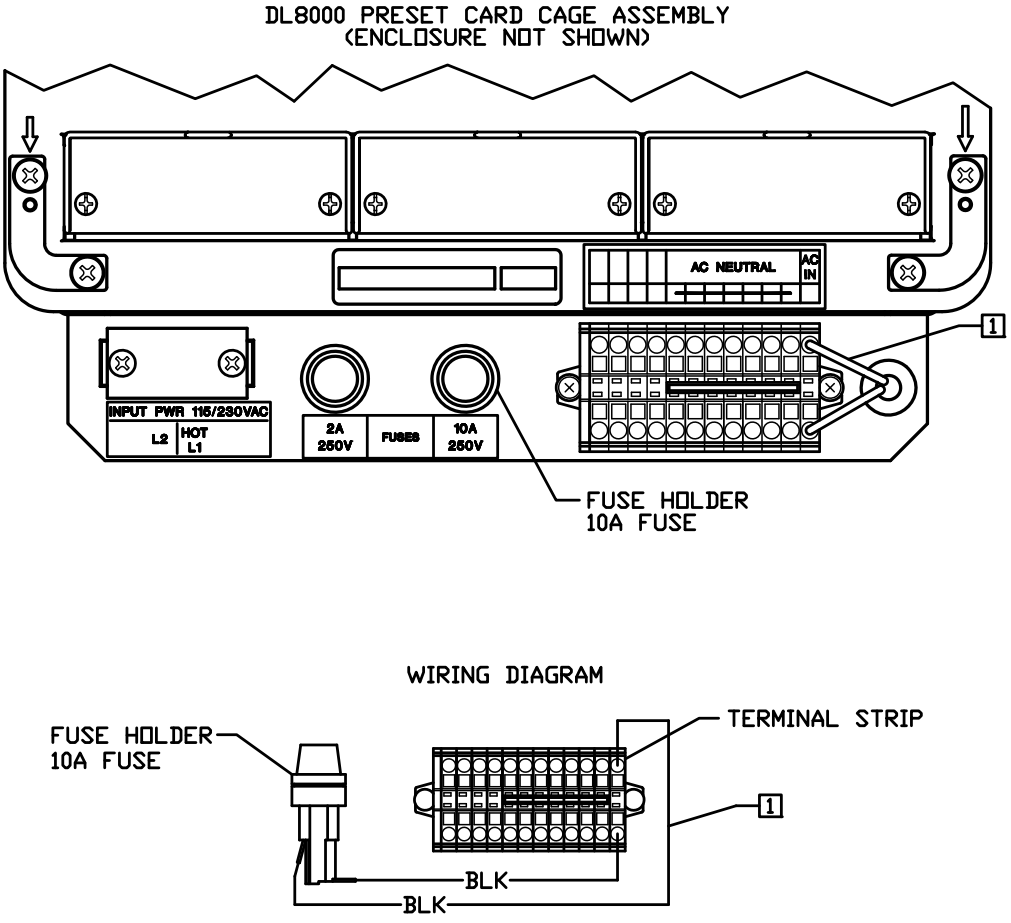


Figure 3-20. Fuse Wiring with Multiple AC I/O Modules

3.2.13 Advance Pulse Module (APM)

The APM provides advanced functionality commonly found in liquids and gas measurement programs, including support for densitometer inputs, detector inputs, pulse inputs, pulse frequencies, and pulse outputs. Field wiring and DIP switch settings provide this flexibility. See *Figures 3-21* through *3-30*.

Note: The DL8000 supports up to nine APMs.

For densitometer inputs, you can designate channel 3 as a pulse input using a frequency input channel with hardware filtering for the Micro Motion® 7835/7845 densitometer. You can designate channel 4 as a pulse input or a solid state pulse output.

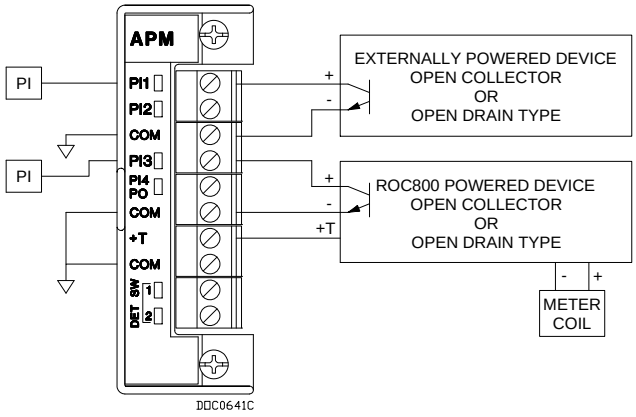


Figure 3-21. Pulse Input Wiring on APM

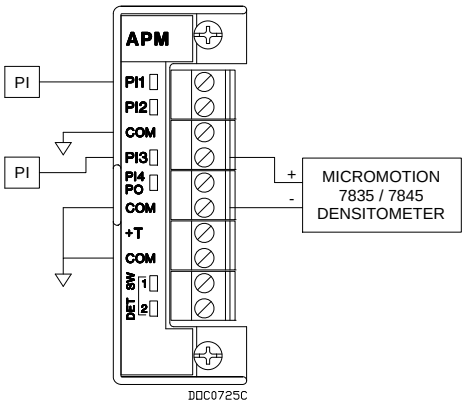


Figure 3-22. MicroMotion 7835/7845 Wiring on APM

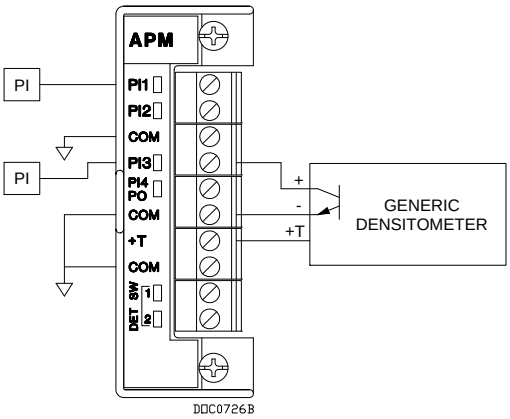


Figure 3-23. Generic Densitometer Wiring on APM

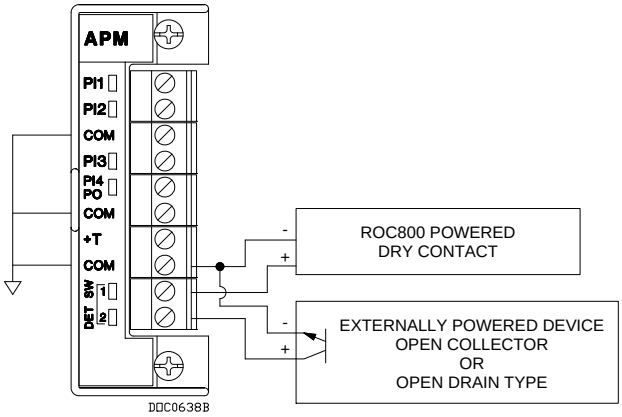


Figure 3-24. Input Detector Wiring on APM

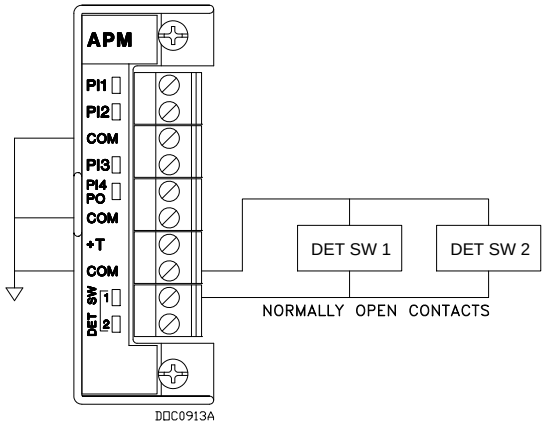


Figure 3-25. Series Detector Switch (Normally Open) Wiring on APM

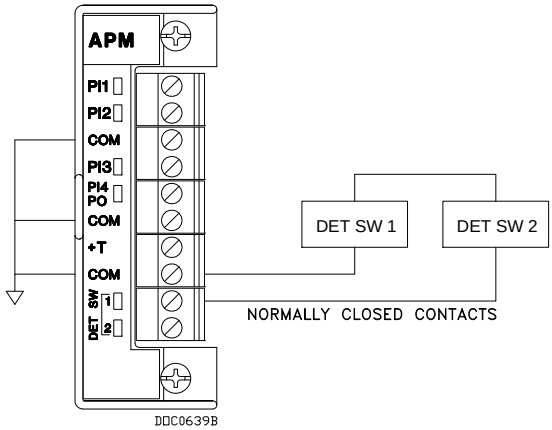


Figure 3-26. Series Detector Switch (Normally Closed) Wiring on APM

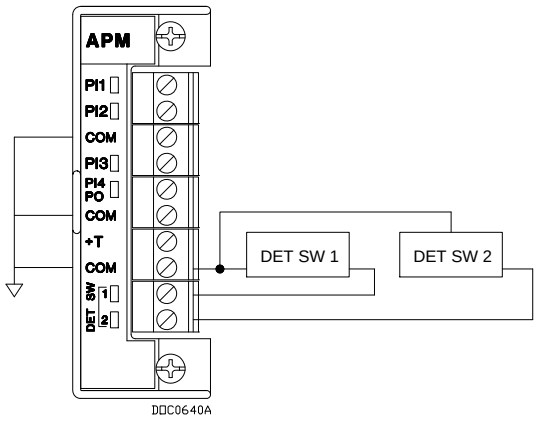


Figure 3-27. Independent Detector Wiring on APM

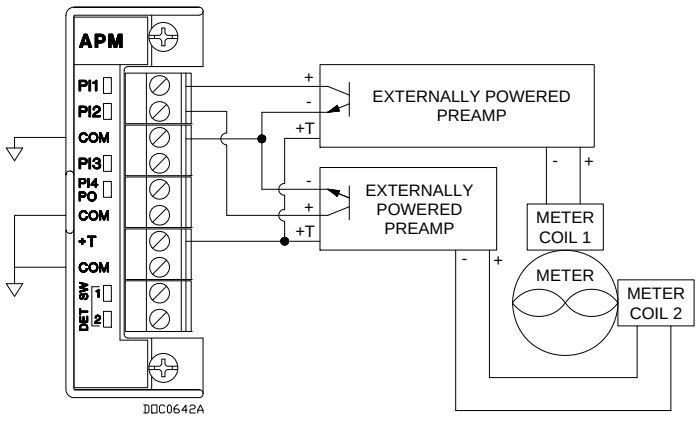


Figure 3-28. Two-Pulse Turbine Pulse Input Wiring on APM

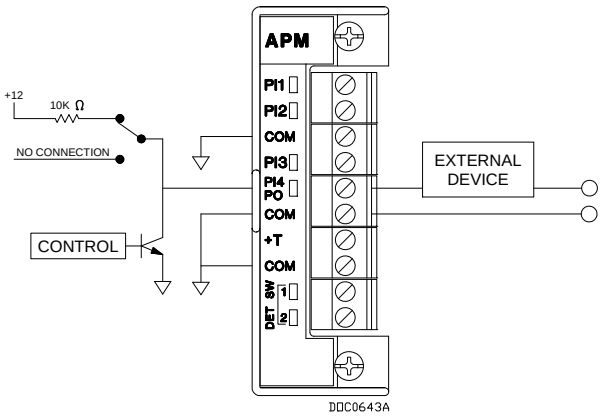


Figure 3-29. Pulse Output Wiring on APM

DIP Switch Settings

The APM card's daughterboard contains several DIP switches which you use to control the module's activities. See *Figure 3-30* for the switch locations and labels; see *Table 3-6* for the settings.

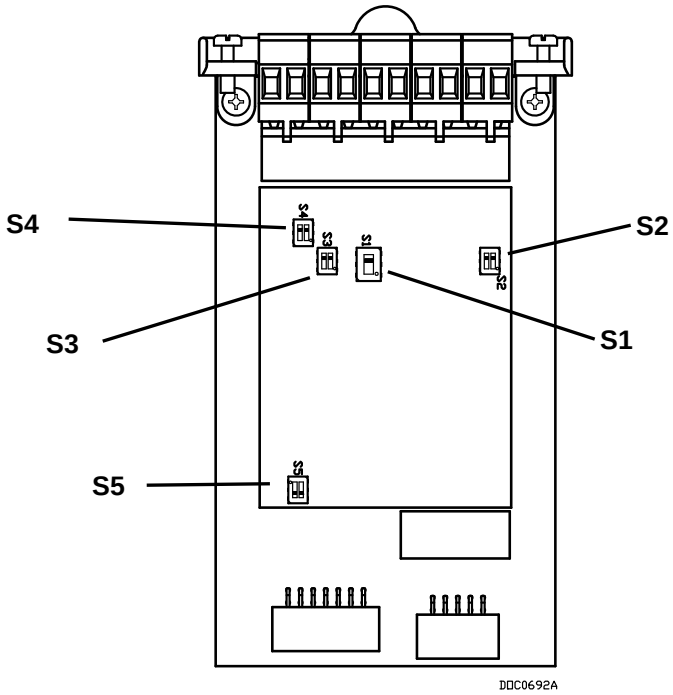


Figure 3-30. DIP Switches on APM

Table 3-6. APM DIP Switch Settings

Switch	Channel	Side[1]	Function	Switch Position[1]
S1	3	N/A	Standard PI	Up
			Current Modulated Densitometer	Down
S2	1[2]	Left	10 kΩ Pullup to 12 V dc	Up
		Left	No Pullup Resistor	Down
	2	Right	10 kΩ Pullup to 12 V dc	Up
		Right	No Pullup Resistor	Down
S3[2]	3	Left	10 kΩ Pullup to 12 V dc	Up
		Left	No Pullup Resistor	Down
	4	Right	10 kΩ Pullup to 12 V dc	Up
		Right	No Pullup Resistor	Down
S4	Detector 2	Left	10 kΩ Pullup to 12 V dc	Up
		Left	No Pullup Resistor	Down
	Detector 1	Right	10 kΩ Pullup to 12 V dc	Up
		Right	No Pullup Resistor	Down
S5	4	Left	Pulse Output	Up
		Left	Pulse Input	Down
	N/A	Right	N/A	N/A

[1]Descriptors (up/down/right/left) assume that module terminal blocks face upward and daughterboard is visible (see *Figure 3-30*)
[2]If S1 is down, the 3-channel of this switch is non-functional; the 4-channel still functions normally.

3.2.14 Thermocouple (TC) Input Module

Caution **The TC2 module is NOT supported in the Series 1 CPU.**

The four-channel Thermocouple Input module monitors types B, C, E, J, K, N, R, S, or T thermocouples, based on how you configure the module with ROCLINK 800 Configuration software. The type of thermocouple refers to the material used to make a bimetallic junction. Dissimilar materials in the thermocouple junction generate different millivolt levels as a function of the heat to which they are exposed.

The Thermocouple module measures the voltage of the thermocouple to which it is connected. The TC voltage is measured and a Cold Junction Compensation (CJC) correction factor is applied to compensate for errors due to any voltage inducted at the wiring terminals by the junction between the different metal of the TC wiring and the TC module's terminal blocks.

Note: The use of dissimilar metals is not supported. It does not provide the correct results, as CJC is applied at the module level.

Thermocouples are self-powered and require no excitation current. The TC module uses integrated short-circuit protected isolated power supplies and completely isolates the field wiring side of the module from the backplane.

Caution **If using the Type J above 750°C (1382°F), abrupt magnetic transformation causes permanent de-calibration of the TC wires.**

De-calibration

De-calibration can occur in thermocouple wires. De-calibration is the process of unintentionally altering the makeup of the thermocouple, usually caused by the diffusion of atmospheric particles into the metal at the extremes of the operating temperature range. Impurities and chemicals can cause de-calibration from the insulation diffusing into the thermocouple wire. If operating at high temperatures, check the specification of the probe insulation. It is advised to use thermocouples with insulated junctions to protect against oxidation and contamination.

Thermocouples use thin wire (typically 32 AWG) to minimize thermal shunting and increase response times. Wire size used in the thermocouple depends upon the application. Typically, when longer life is required for the higher temperatures, select the larger size wires. When sensitivity is the prime concern, use smaller size wiring. Thin wire causes the thermocouple to have a high resistance that can cause errors due to the input impedance of the measuring instrument. If thermocouples with thin leads or long cables are required, keep the thermocouple leads short and use a thermocouple extension wire to run between the thermocouple and measuring instrument.

The thermocouple connects directly to the module's removable terminal block (see *Figure 3-31*). No special terminal or isothermal block is required.

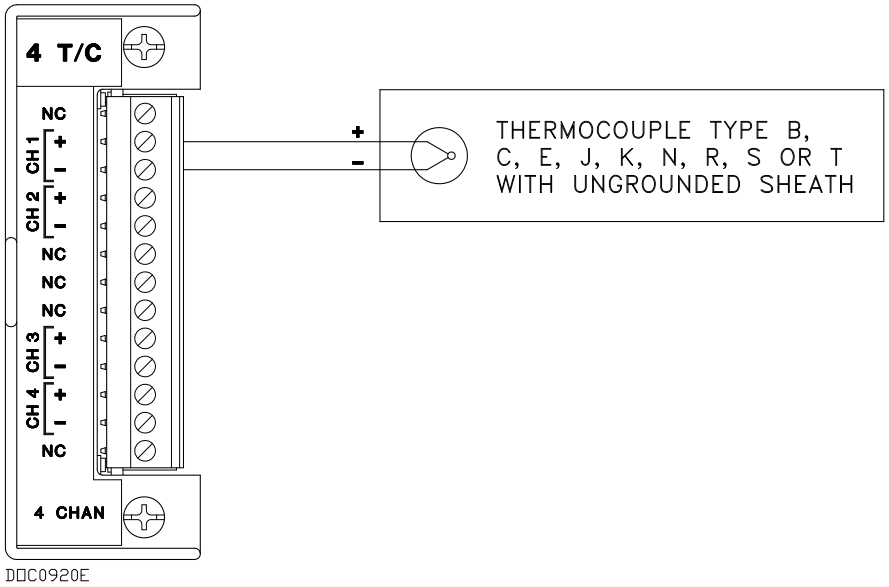


Figure 3-31. Thermocouple Input Module Wiring

Be sure to use the correct type of thermocouple wire to connect the thermocouple to the DL8000. Minimize connections and make sure connections are tight. If you use any dissimilar metals (such as copper wire) to connect a thermocouple to the DL8000, you can create the junction of dissimilar metals that can generate millivolt signals and increase reading errors.

Ensure any plugs, sockets, or terminal blocks used to connect the extension wire are made from the same metals as the thermocouples and observe correct polarity.

The thermocouple probe must have sufficient length to minimize the effect of conduction of heat from the hot end of the thermocouple. Unless there is insufficient immersion, readings will be low. It is suggested the thermocouple be immersed for a minimum distance equivalent to four times the outside diameter of a protection tube or well.

Use only ungrounded thermocouple constructions. Grounded thermocouples are susceptible to the creation of ground loops. In turn, ground loops can cause interaction between thermocouple channels on the thermocouple module.

Note: Use thermocouples as individual sensing devices. All modules are isolated on the field side. Be aware that you can induce ground loops by tying module-to-module commons together.

Noise Susceptibility

Millivolt signals are very small and are very susceptible to noise. Noise from stray electrical and magnetic fields can generate voltage

signals higher than the millivolt levels generated from a thermocouple. The TC modules can reject common mode noise (signals that are the same on both wires), but rejection is not perfect, so minimize noise where possible.

Take care to properly shield thermocouple wiring from noise by separating the thermocouple wiring runs from signals that are switching loads and AC signals. Route wires away from noisy areas and twist the two insulated leads of the thermocouple cable together to help ensure both wires pickup the same noise. When operating in an extremely noisy environment, use a shielded extension cable.

⚠ Caution **Shielded wiring is highly recommended. Ground shields only on one end, preferably at the end device unless you have an excellent ground system installed at the ROC800-series controller. Do not tie the thermocouple module to ground.**

Sheathed thermocouple probes are available with one of three junction types: grounded, ungrounded, or exposed.

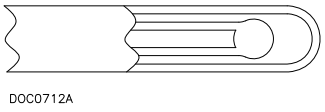


Figure 3-32. Ungrounded – Sheathed

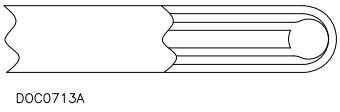


Figure 3-33. Grounded

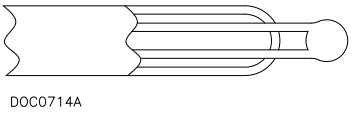


Figure 3-34. Exposed, Ungrounded – Unsheathed

In an **ungrounded** probe, the thermocouple junction is detached from the probe wall. Response time slows down from the grounded style, but the ungrounded probe offers electrical isolation of 1.5 M Ω at 500 Volts dc in all diameters. The wiring may or may not be sheathed.

Note: Only **ungrounded** probes are supported. It is highly recommended that you use sheathed probes.

Use an ungrounded junction for measurements in corrosive environments where it is desirable to have the thermocouple electronically isolated from and shielded by the sheath. The welded wire thermocouple is physically insulated from the thermocouple sheath by MgO powder (soft).

At the tip of a **grounded** junction probe, the thermocouple wires physically attach to the inside of the probe wall. This results in good heat transfer from the outside, through the probe wall to the thermocouple junction. Grounded wiring is not supported.

The thermocouple in the **exposed** junction protrudes out of the tip of the sheath and is exposed to the surrounding environment. This type offers the best response time, but is limited in use to non-corrosive and non-pressurized applications. **Exposed junction thermocouples are not supported.**

Note: Avoid subjecting the thermocouple connections and measurement instrument to sudden changes in temperature.

3.2.15 Highway Addressable Remote Transducer (HART®) Module

Note: The HART-2 module (labeled **HART-2** with black faceplate) replaces the HART module (with gray faceplate).

The HART-2 module allows a DL8000 to communicate with HART devices using the HART protocol. The HART-2 module receives signals from and transmits signals to HART devices. LEDs provide a visual indication of the status of each HART channel. Refer to *Figures 3-35* to *3-37*.

Note: HART Pass-Through requires you to use the HART Pass-Through license key (FS8KY-6), which provides PlantWeb® Smart Remote Automation functionality. This includes the ability to pass HART data bi-directionally through the network to AMS™ Device Manager software.

The module has four input/output channels. The HART-2 module uses software-configurable switches, which allow you to set each channel as input or output. When you set a channel as an input, you can configure it for use in point-to-point or multi-drop mode (which typically connects to some type of transmitter, such as a temperature reading). When you configure a channel as an output, it reverts to point-to-point mode **only**. The output supports a Digital Valve Controller (DVC). Each channel has analog input capability intended for diagnostic and primary process variable measurement.

Frequency Shift Keying

HART superimposes Frequency Shift Keying (FSK) signals on an analog signal. This technique allows digital information to be passed to and from the HART device on a 4 to 20 mA analog signal.

Point-to-Point Mode

In **point-to-point** mode, the analog signal is still representative of the measured variable. This mode allows communications with one HART device per channel.

Multi-drop Mode

In **multi-drop mode**, you can connect up to five HART devices (in parallel) to each channel. As with the point-to-point mode, digital communications are superimposed on the analog signal used to power the HART devices. Each HART device in multi-drop mode requires 4 mA and the current does not represent any measured variable value. With all four channels in the multi-drop mode, the DL8000 can support a maximum of twenty HART devices.

A DL8000 equipped with a HART-2 module is considered to be a HART Host (primary master) interface with a Class 1 Conformance classification. The HART-2 module can also be configured with

ROCLINK 800 Configuration software for use as a secondary master in redundant applications.

Most Universal and some Common Practice commands are supported. For a list of the commands, refer to the ROC800-Series HART-2 Module technical specification sheet (*ROC800:HART2*). The supported commands conform to HART Universal Command Specification Revision 5.1 and Common Practice Command Specification Revision 7, (HCF SPEC 127 and 151). Refer to *www.hartcomm.org* for more information on the specifications.

The HART-2 module polls the channels simultaneously. If more than one device is connected to a channel in a multi-drop configuration, the module polls one device per channel at a time. The HART protocol allows one second per poll for each device, so with five devices per channel the maximum poll time for the channel would be five seconds.

Note: The DL8000 **does not** support HART devices configured in Burst mode (in which the device sends information without a prior request). If you have a HART device configured in burst mode, use a hand-held field communicator to turn off burst mode **before** you connect the device to the DL8000.

The HART-2 module provides "loop source" power (+T) and four channels (1+ through 4+) for communications. The +T power is current-limited.

DL8000-powered HART Devices

When using the DL8000 to power HART devices, connect terminal +T in parallel to the positive (+) terminal on all of the HART devices, regardless of the channel to which they are connected.

Wire channel 1+ to the negative (–) terminal of a single HART device, or in parallel to the negative terminals of the devices. Likewise, wire channel 2+ to the negative (–) terminal of a single HART device, or in parallel to the negative terminals of a second group of HART devices (see *Figures 3-35* to *3-37*).

Externally powered HART Devices

When powering HART devices by an external device, connect the positive (+) terminal from the power source in parallel to the positive (+) terminal on all of the HART devices, regardless of the channel to which they are connected.

Wire channel 1+ on the HART-2 module to the positive (+) terminal of the HART device. Connect the power source negative (–) terminal to the channel's COM terminal and to the negative (–) terminal of a single HART device, or in parallel to the negative terminals of the HART devices.

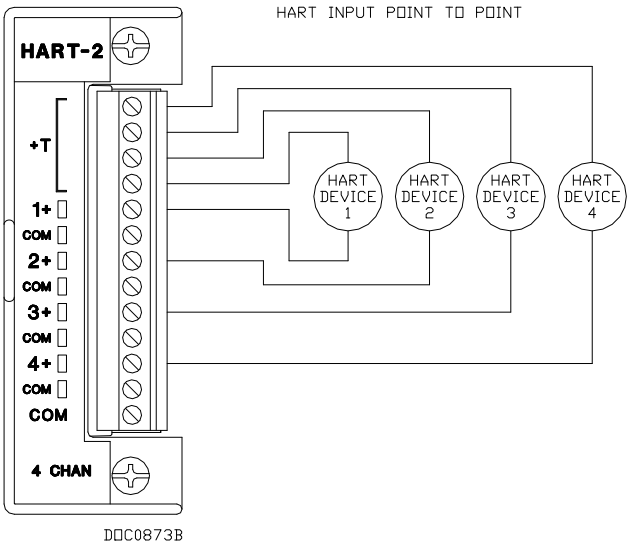


Figure 3-35. Input Point-to-Point Wiring on HART-2 Module

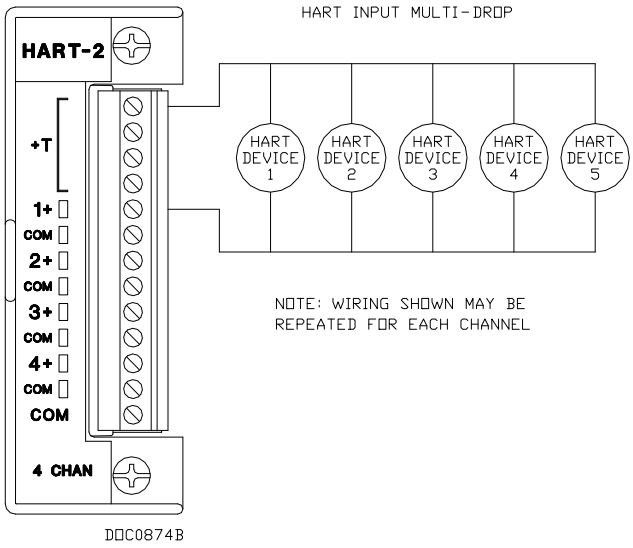


Figure 3-36. Input Multi-Drop Wiring on HART-2 Module

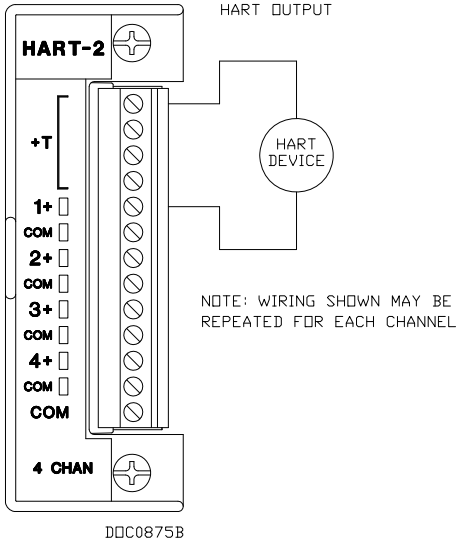


Figure 3-37. Output Wiring on HART-2 Module

3.3 Communication Modules and Ports

The built-in communications and the optional communication modules provide communications between the DL8000 and a host system or external devices.

The DL8000 allows up to six communication ports. Three communication ports are built-in on the CPU and up to three additional

ports may be added with communication modules. *Table 3-7* displays the types of communications available for the DL8000; *Table 3-8* defines the LED indicators.

Table 3-7. Built-in Communications and Optional Communications Modules

Communications	Built-in on CPU	Optional Module
EIA-232 (RS-232D) Local Operator Interface (LOI)	Local Port	
Ethernet (use with DS800 Configuration Software)	Comm1	
EIA-232 (RS-232C) Serial Communications	Comm2	Comm3 to Comm5
EIA-422/485 (RS-422/485) Serial Communications		Comm3 to Comm5
Modem Communications		Comm3 to Comm5

The communications modules consist of a communications module (card), a communications port, wiring terminal block, LEDs, and connectors to the backplane. The DL8000 can hold up to three communication modules in the first three module slots. See *Figure 3-38*.

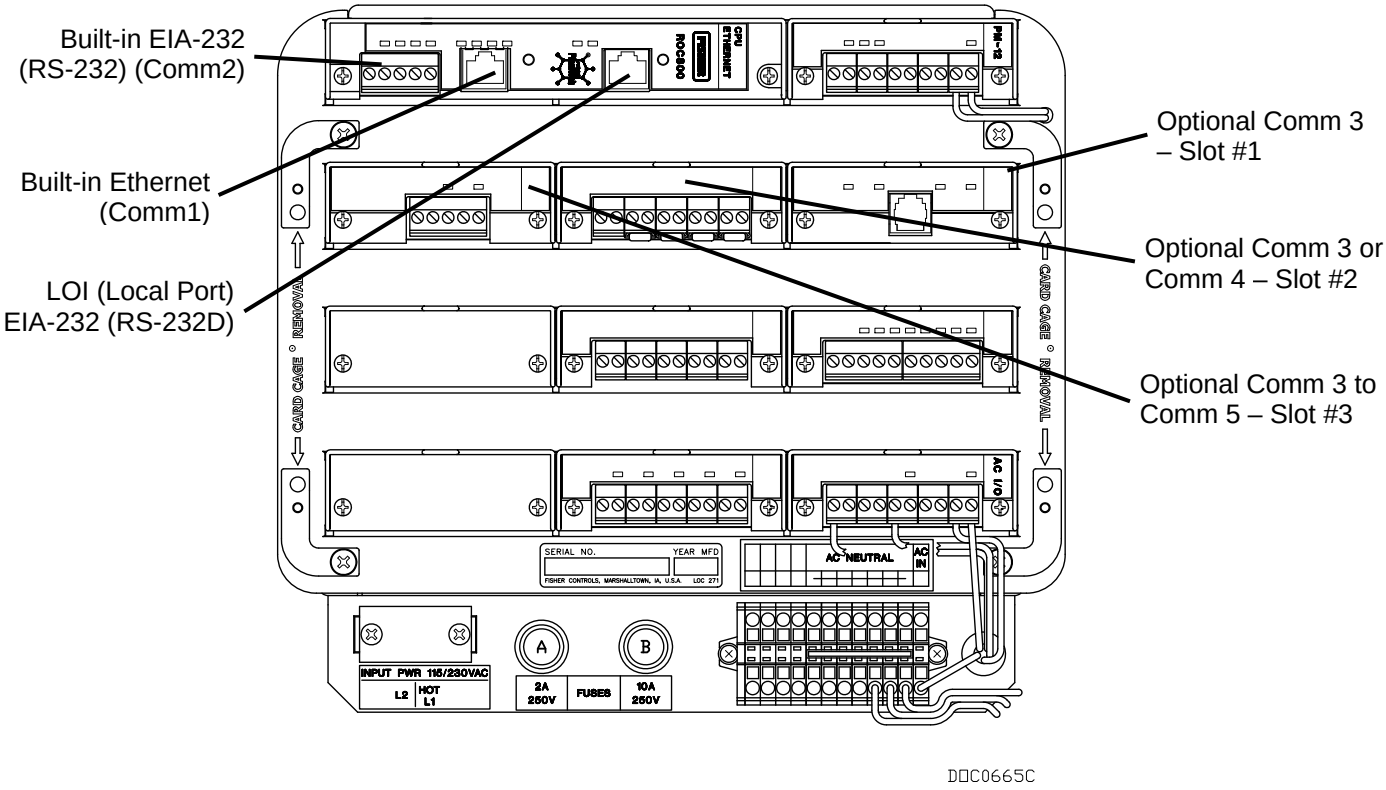


Figure 3-38. Communication Ports

Table 3-8. Communication LED Indicator Definitions

Signals	Action
CTS	**Clear To Send** indicates the modem is ready to send.
CD	Data **Carrier Detect** (DCD) indicates a valid carrier signal tone detected.
DSR	**Data Set Ready** for ring indicator communication signal.
DTR	**Data Terminal Ready** to answer an incoming call. When off, a connection disconnects.
RTS	**Ready To Send** indicates ready to transmit.
RX	**Receive Data** (RD) signal is being received.
TX	**Transmit Data** (TD) signal is being transmitted.

Each communications module has surge protection in accordance with the CE certification EN 61000. Each communications module is completely isolated from other modules and the backplane, including power and signal isolation, with the exception of the EIA-232 (RS-232) module. The field interface has been designed to protect the electronics in the module. Filtering is provided on each module to reduce communication errors.

3.3.1 Wiring Communications

Signal wiring connections to the communications are made through the communications port removable terminal bock connectors and through RJ-11 and RJ-45 connectors. All modules have removable terminal blocks for convenient wiring and servicing. The terminal blocks accommodate wire sizes between 12 and 22 AWG.

⚠ Caution **Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.**

To connect the wire to the removable block compression terminals:

1. Bare the end (¼ inch maximum) of the wire.
2. Insert the bared end into the clamp beneath the termination screw.
3. Tighten the screw.

Expose a minimum of bare wire to prevent short circuits. Allow some slack when making connections to prevent strain.

Note: All modules have removable terminal blocks for convenient wiring and servicing. Twisted-pair cable is recommended for I/O signal wiring. The removable terminal blocks accept wire sizes between 12 and 22 AWG.

3.3.2 Local Operator Interface (LOI – Local Port)

The Local Operator Interface (LOI) port provides direct communications between the DL8000 and the serial port of an operator interface device, such as a personal computer (PC). The interface allows you to access the DL8000 with a direct connection using ROCLINK 800 software for configuration and transfer of stored data.

The LOI uses the Local Port in ROCLINK 800 software.

The LOI terminal (RJ-45) on the CPU (see *Figure 3-38*) provides wiring access to a built-in EIA-232 (RS-232) serial interface, which is capable of 57.6K baud operation. The RJ-45 connector pin uses the data terminal equipment (DTE) in the IEEE standard.

The LOI port supports ROC Plus and Modbus protocol communications. The LOI also supports the log-on security feature of the DL8000 if you enable the Security on LOI feature in ROCLINK 800 software.

Table 3-9 shows the signal routing of the CPU connections. *Figure 3-39* shows the RJ-45 pin out.

Table 3-9. Built-in LOI EIA-232 Signal Routing

Signal	LOI Function	RJ-45 Pins on DL8000	Description
DTR	Data Terminal Ready	3	Originated by the DL8000 Data Terminal Equipment (DTE) to instruct the Data Communication Equipment (DCE) to set up a connection. DTE is running and ready to communicate.
GND	Ground (Common)	4	Reference ground between a DTE and a DCE and has a value 0 volts dc.
RX	Receive	5	Data received by the DTE.
TX	Transmit	6	Data sent by the DTE.
RTS	Request to Send	8	Originated by the DTE to initiate transmission by the DCE.

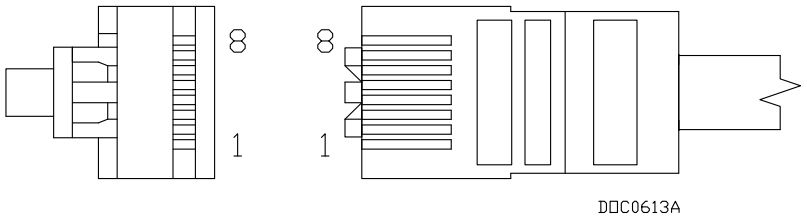


Figure 3-39. RJ-45 Pin Out

The LOI terminal requires a D-Sub 9 pin (F) to RJ-45 modular converter installed between the DL8000 and a personal computer (PC). See *Table 3-10.*

Table 3-10. RJ-45 to EIA-232 (RS-232) Null-modem Cable Signal Routing

EIA-232 (RS-232) DTE	DL8000	RJ-45 Pins on DL8000
4	–	1
1	–	2
6	DTR	3
5	GND	4
3	TX	5
2	RX	6
7	–	7
8	RTS	8

Adaptor Cable Remote Automation Solutions offers an adaptor cable to resolve this cabling issue. Order CBL8A from your Remote Automation Solutions salesperson.

3.3.3 Using the LOI

1. Plug the LOI cable into the LOI connector on the DL8000 CPU.
2. Connect the LOI cable to the D-Sub 9 pin (F) to RJ-45 modular converter.
3. Plug the modular converter into the PC's serial COM port.
4. Launch ROCLINK 800 software.
5. Click the **Direct Connect** icon.
6. Configure communications for the other built-in and modular communications, I/O modules, AGA meter parameters, and other configuration parameters.

3.3.4 Ethernet Communications

The Ethernet communications port in the DL8000 allows TCP/IP protocol communications using the IEEE 802.3 10Base-T standard. One application of this communications port is for downloading programs from DS800 Development Suite Configuration Software.

The Ethernet communications port uses a 10BASE-T Ethernet interface with an RJ-45 connector. Each Ethernet-equipped unit is called a station and operates independently of all other stations on the network without a central controller. All attached stations connect to a shared media system. Signals are broadcast over the medium to every attached station. To send an Ethernet packet, a station listens to the medium (Carrier Sense) and when the medium is idle, the station transmits the data. Each station has an equal chance to transmit (Multiple Access).

Access to the shared medium is determined by the Medium Access Control (MAC) mechanism embedded in each station interface. The MAC mechanism is based on Carrier Sense Multiple Access with Collision Detection (CSMA/CD). If two stations begin to transmit a packet at the same instant, the stations stop transmitting (Collision Detection). Transmission is rescheduled at a random time interval to avoid the collision.

Link Ethernet networks together to form extended networks using bridges and routers. *Table 3-11* maps the LEDs to functions.

Table 3-11. Ethernet Signal LEDs

Signal	Function
RX	Lit when currently receiving.
TX	Lit when currently transmitting.
COL	Lit when Ethernet Packet Collision detected.
LNK	Lit when Ethernet has linked.

Use a rugged industrial temperature HUB when connecting Ethernet wiring in an environment that requires it.

The IEEE 802.3 10BASE-T standard requires that 10BASE-T transceivers be able to transmit over a link using voice grade twisted-pair telephone wiring that meets EIA/TIA Category four wire specifications. Generally, links up to 100 meter (328 feet) long are achievable for unshielded twisted-pair cable.

For each connector or patch panel in the link, subtract 12 meters (39.4 feet) from the 100-meter limit. This allows for links of up to 88 meters (288 feet) using standard 24 AWG UTP (Unshielded Twisted-Pair) wire and two patch panels within the link. Higher quality, low attenuation cables may be required when using links greater than 88 meters.

The maximum insertion loss allowed for a 10BASE-T link is 11.5 dB at all frequencies between 5.0 and 10.0 MHz. This includes the attenuation of the cables, connectors, patch panels, and reflection losses due to impedance mismatches to the link segment.

Intersymbol interference and reflections can cause jitter in the bit cell timing, resulting in data errors. A 10BASE-T link must not generate more than 5.0 nanoseconds of jitter. If your cable meets the impedance requirements for a 10BASE-T link, jitter should not be a concern.

The maximum propagation delay of a 10BASE-T link segment must not exceed 1000 nanoseconds.

Crosstalk is caused by signal coupling between the different cable pairs contained within a multi-pair cable bundle. 10BASE-T transceivers are designed so that you do not need to be concerned about cable crosstalk, provided the cable meets all other requirements.

Noise can be caused by crosstalk of externally induced impulses. Impulse noise may cause data errors if the impulses occur at very specific times during data transmission. Generally, do not be concerned about noise. If you suspect noise related data errors, it may be necessary to either reroute the cable or eliminate the source of the impulse noise.

Multi-pair, PVC 24 AWG telephone cables have an attenuation of approximately 8 to 10 dB/100 m at 200°C (392°F). The attenuation of PVC insulted cable varies significantly with temperature. At temperatures greater than 400°C (752°F), use plenum rated cables to ensure that cable attenuation remains within specification.

When connecting two twisted-pair MAUs (Medium Attachment Units) or repeaters together over a segment, wire the transmit data pins of one eight-pin connector to the receive data pins of the other connector, and vice versa. There are two methods for accomplishing 10BASE-T crossover wiring:

- Special cable.
- Wire the 10BASE-T crossover inside the hub.

For a single segment connecting only two devices, provide the signal crossover by building a special crossover cable, wire the transmit data pins of one eight-pin connector to the receive data pins of the other connector, and vice versa. See *Figure 3-40*.

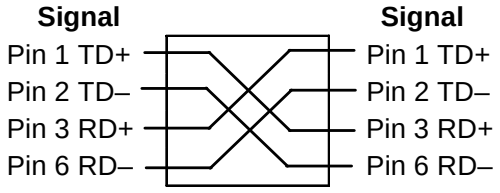


Figure 3-40. 10BASE-T Crossover Cable

3.3.5 EIA-232 (RS-232) Serial Communications

The built-in EIA-232 (RS-232), the LOI, and the communication modules meet all EIA-232 (RS-232) specifications for single-ended, asynchronous data transmission over distances of up to 15 meters (50 feet). EIA-232 (RS-232) communication provides transmit, receive, and modem control signals. The LOI port also meets EIA-232D (RS-232D) specifications.

The EIA-232 (RS-232) communications have the following communication port designations in ROCLINK 800.

- **LOI** – Local Port EIA-232 (RS-232D). Refer to *Section 3.3.2, Local Operator Interface*.
- **Built-in** – Comm2 EIA-232 (RS-232C).

- **Module** – Comm3 to Comm5 EIA-232 (RS-232C).

EIA-232 (RS-232) uses point-to-point asynchronous serial communications and is commonly used to provide the physical interface for connecting serial devices, such as gas chromatographs and radios to the DL8000. The EIA-232 (RS-232) communication provides essential hand-shaking lines required for radio communications, such as DTR and RTS.

The EIA-232 (RS-232) communications includes LED indicators that display the status of the Receive (RX), Transmit (TX), Data Terminal Ready (DTR), and Ready To Send (RTS) control lines.

Table 3-12 defines the built-in EIA-232 (RS-232) terminals at the Comm2 port and their function signals.

Table 3-12. Built-in EIA-232 (RS-232) Signal Routing – Comm2

Signal	LED Function	Terminal
RX	Lit when Comm2 is currently receiving.	1
TX	Lit when Comm2 is currently transmitting.	2
RTS	Lit when Comm2 ready to send is not active.	3
DTR	Lit when Comm2 data terminal ready is active.	4
GND	Common.	5

The EIA-232 (RS-232) communications module provides for EIA-232 (RS-232C) signals on the Comm3, Comm4, or Comm5 port depending on where the module is installed. See *Table 3-13*.

Table 3-13. EIA-232 (RS-232) Communication Module Signal Routing – Comm3, Comm4, and Comm5

Signal	LED Function	Terminal
RX	Lit when module (Comm3, Comm4, or Comm5) is currently receiving.	1
TX	Lit when module (Comm3, Comm4, or Comm5) is currently transmitting.	2
RTS	Lit when module (Comm3, Comm4, or Comm5) is ready to send is not active.	3
DTR	Lit when module (Comm3, Comm4, or Comm5) data terminal ready is active.	4
GND	Common.	5

3.3.6 EIA-422/485 (RS-422/485) Serial Communications Module

EIA-422/485 (RS-422/485) communication modules meet all EIA-422/485 (RS-422/485) specifications for differential, asynchronous serial communication transmissions of data over distances of up to 1220 meters (4000 feet). EIA-485 (RS-485) communications are commonly used to multi-drop units on a serial network over long distances using inexpensive twisted-pair wiring.

EIA-422 (RS-422) drivers are designed for party-line applications where one driver is connected to, and transmits on, a bus with up to ten receivers. EIA-422 (RS-422) allows long distance point-to-point

communications and the drivers are designed for true multi-point applications with up to 32 drivers and 32 receivers on a single bus.

The default values for the EIA-422/485 (RS-422/485) communications are: 19200 Baud rate, 8 data bits, 1 stop bit, and no parity. The maximum rate is 57.6K bps.

EIA-422/485 (RS-422/485) communication modules include LED indicators that display the status of receive and transmit activity. See *Tables 3-14* and *3-15*.

Table 3-14. EIA-422 (RS-422) Signal Routing – Comm3, Comm4, and Comm5

Signal	RS-422	Function	Terminal
A	RX +	Lit when module (Comm3, Comm4, or Comm5) is currently receiving.	1
B	RX –	None.	2
Y	TX +	Lit when module (Comm3, Comm4, or Comm5) is currently transmitting.	3
Z	TX –	None.	4
COM	Common	Ground.	5

Table 3-15. EIA-485 (RS-485) Signal Routing – Comm3, Comm4, and Comm5

Signal	RS-485	Function	Terminal
A	RX / TX +	Lit when module (Comm3, Comm4, or Comm5) is currently receiving.	1
B	RX / TX –	Lit when module (Comm3, Comm4, or Comm5) is currently transmitting.	2
Y	No Connect	None.	3
Z	No Connect	None.	4
COM	Common	Ground.	5

Note: The EIA-422/485 (RS-422/485) modules are isolated on the field side.

Caution **You can induce ground loops by tying commons from various modules together.**

EIA-422/485 (RS-422/485) communications provides EIA-422/485 (RS-422/485) signals on the Comm3, Comm4, or Comm5 port depending on where the module is installed. Wiring should be twisted-pair cable, one pair for transmitting, and one pair for receiving. The EIA-422 (RS-422) module uses four wires and the EIA-485 (RS-485) uses two wires for connectivity.

3.3.7 EIA-422/485 (RS-422/485) Jumpers and Termination Resistors

Four jumpers—J3, J4, J5, and J6—are located on the EIA-422/485 (RS-422/485) communications module (see *Figure 3-41*). These jumpers determine in which mode the module runs (RS-422 or RS-485) and if the module is terminated. See *Tables 3-16* and *3-17*.

Terminations are required on the two EIA-422/485 (RS-422/485) communication modules located at the extremities of the circuit. That is to say, the two outside modules require terminations in order to complete the communications circuit.

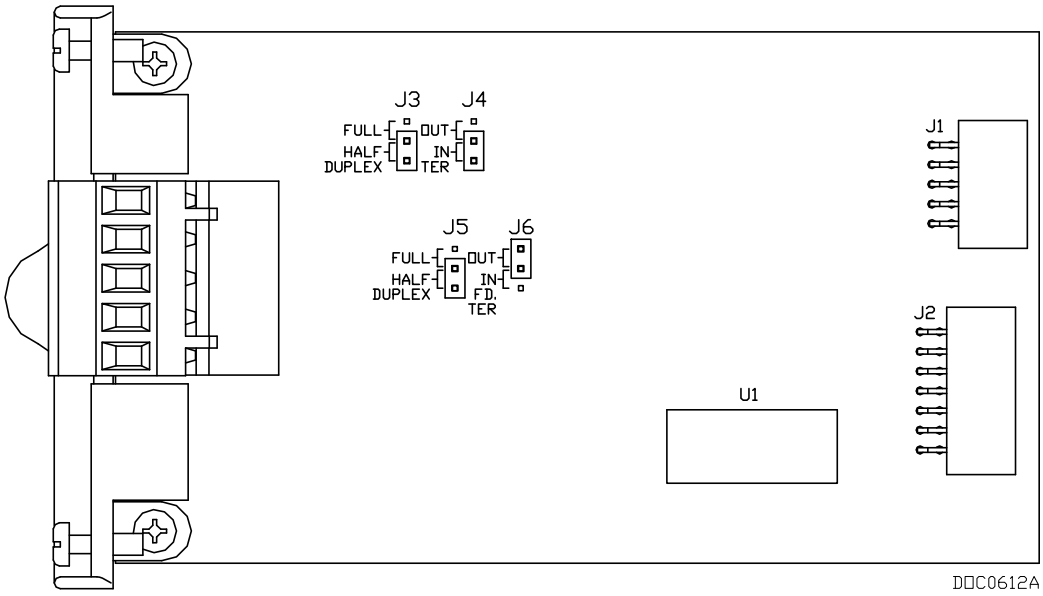


Figure 3-41. EIA-422/485 (RS-422/485) J4 Jumper

Table 3-16. EIA-422 (RS-422) Module

Jumper	Terminated				Not Terminated			
	TER	Out	Half	Full	TER	Out	Half	Full
J3				x				x
J4	x					x		
J5				x				x
J6	x					x		

Table 3-17. EIA-485 (RS-485) Module

Jumper	Terminated				Not Terminated			
	TER	Out	Half	Full	TER	Out	Half	Full
J3			x				x	
J4	x					x		
J5			x				x	
J6		x				x		

3.3.8 Dial-up Modem Communications Module

The dial-up modem module interfaces to a Public-Switched Telephone Network (PSTN) line. The dial-up modem module provides for a telephone interface on the host port that is capable of both answering

and originating telephone calls. The dial-up modem module also provides electronics that conserve power when the phone line is not in use. The dial-up modem module requires a telephone line connection.

Note: When installing a dial-up modem module, you must remove power from the DL8000.

The dial-up modem provides communications with speeds up to 14.4K bps with V.42 bis and V.42, MNP2-4 and MNP10 error correction.

The dial-up modem module is FCC Part 68 approved for use with PSTNs. The FCC label on the module provides the FCC registration number and the ringer equivalent. The dial-up modem module supports data compression, error correction, and nonvolatile RAM for permanent storage of the modem configuration.

The dial-up modem module interfaces to two-wire, full-duplex telephone lines using asynchronous operation. The module interfaces to a PSTN through an RJ-11 jack. The dial-up modem can be controlled using industry-standard AT command software. A 40-character command line is provided for the AT command set, which is compatible with EIA document TR302.2/88-08006.

The dial-up modem automatically hangs up after a configured period of communications inactivity. The dial-up modem provides automated dial-up alarm reporting capabilities.

Table 3-18. RJ-11 Field Connections

Signal	Pin
Tip	3
Ring	4

LED indicators on the module show the status of the Receive (RX), Transmit (TX), Ring (RI), and Carrier Detect (CD) control lines. *Table 4-19* displays connector signals and their functions.

Table 3-19. Modem Signal Routing – Comm3, Comm4, and Comm5

Signal	Function	Terminal
RX	Lit when module (Comm3, Comm4, or Comm5) is currently receiving.	1
TX	Lit when module (Comm3, Comm4, or Comm5) is currently transmitting (Tip).	3
RI	Lit when module (Comm3, Comm4, or Comm5) on ring (Ring).	7
CD	Lit when module (Comm3, Comm4, or Comm5) on carrier detect.	9

Notes:

- If you are installing a modem module, it is recommended that you install a surge protector between the RJ-11 jack and the outside line.

- The dial-up modem is **not** hot-swappable **or** hot-pluggable. When installing a dial-up modem module, you **must** remove power from the DL8000.

3.4 Additional Technical Information

Refer to the following technical documentation (available at *www.EmersonProcess.com/Remote*) for additional and most-current information on each of the modules.

Table 3-20. I/O Module Technical Specifications

Name	Form Number	Part Number
ROC800-Series Analog Input Modules	ROC800:AI	D301238X012
ROC800-Series Alternating Current I/O Module	ROC800:ACIO	D301243X012
ROC800-Series Analog Output Module	ROC800:AO	D301260X012
ROC800-Series Advance Pulse Module	ROC800:APM	D201231X012
ROC800-Series Discrete Input Module	ROC800:DI	D301274X012
ROC800-Series Discrete Output Module	ROC800:DO	D301592X012
ROC800-Series Discrete Output Relay Module	ROC800:DOR	D301593X012
ROC800-Series HART® -2 Module	ROC800:HART2	D301705X012
ROC800-Series MVS I/O Module	ROC800:MVS	D301277X012
ROC800-Series Pulse Input Module	ROC800:PI	D301275X012
ROC800-Series Resistance Temperature Detector Module	ROC800:RTD	D301574X012
ROC800-Series Thermocouple Module	ROC800:TC2	D301689X012
ROC800-Series Power Input Modules	ROC800:PIM	D301192X012
ROC800-Series Communication Modules	ROC800:COM	D301171X012

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Appendix A – Glossary

Note: This is a generalized glossary of terms. Not all the terms may necessarily correspond to the particular device or software described in this manual. For that reason, the term "ROC" identifies all varieties of remote operations controllers.

A

A/D Analog to Digital signal conversion.

ABS Acrylonitrile Butadiene Styrene.

ADC Analog to Digital Converter. Used to convert analog inputs (AI) to a format the flow computer can use.

Additive A liquid that is injected into a primary liquid component in relatively small quantities, usually less than four percent of the delivered volume total. Additives are injected into the primary liquid component by an injector mechanism which places a known, fixed volume of the additive into the primary liquid component stream for each injector pulse received from the DL8000 Preset.

AGA American Gas Association. A professional organization that oversees the AGA3 (orifice), AGA5 (heating value), AGA7 (turbine), AGA8 (compressibility), and AGA11 (ultrasonic) gas flow calculation standards. See http://www.aga.org.

AWG American Wire Gauge.

AI Analog Input.

AO Analog Output.

Analog Analog data is represented by a continuous variable, such as an electrical current signal.

Annubar A device that uses Pitot tubes to measure the gas flow rate within a pipeline. The gas volume is calculated from the difference between the flowing pressure and the static pressure of the gas.

AP Absolute Pressure.

API American Petroleum Institute. See http://www.api.org.

Area A user-defined grouping of database entities.

Arm A movable pipe or hose assembly used at a tanker truck loading island (also: *swing arm, loading arm*). The arm can be designed for either top loading or bottom loading to the tanker compartments. A *swing arm* can be positioned to load at either side of the loading island or the parked state.

ASCII American (National) Standard Code for Information Interchange.

Attribute A parameter that provides information about an aspect of a database point. For example, the alarm attribute is an attribute that uniquely identifies the configured value of an alarm.

B

Batch A preset, quantity-based product delivery or blended component delivery of a single recipe.

Blend Stream A product stream blended of both gasoline and ethanol.

Blending	The process of mixing two or more liquid components to form a composite delivered stream. The DL8000 controls blending based on a predetermined recipe by either the sequential (automatic or manual) or the inline (proportional or non-proportional) method. The quantity of each component in a blend is typically greater than two to four percent of the blended product. Injection of very small quantities of liquids, less than four percent of the blended product, is usually controlled by the additive injection process.
BMV	Base Multiplier Value, used in AGA7 (turbine) calculations.
BPS	Bits Per Second, associated with baud rate.
BTU	British Thermal Unit, a measure of heat energy.
Built-in I/O	I/O channels that are fabricated into the ROC and do not require a separate option. Also called “on-board” I/O.

C

CID2	Class I, Division 2 hazardous area
CF	Compare Flag; stores the Signal Value Discrete (SVD).
CMOS	Complementary Metal Oxide Semiconductor, a type of microprocessor used in a ROC.
Coil	Digital output, a bit to be cleared or set.
COL	Ethernet Packet Collision.
COM	Communications port on a personal computer (PC).
COMM	Communications port on a ROC used for host communications.
Comm Module	Module that plugs into a ROC to provide a channel for communications via a specified communications protocol, such as EIA-485 (RS-485) or HART.
Component	Any liquid metered and controlled by the DL8000. Liquid hydrocarbons refined from crude oil and LPGs (such as propane) are usually referred to as *products*. Components are base products or tank products stored at a distribution terminal. The component is measured before being blended with other components. Additives may be injected before (upstream of) or after (downstream of) the component meter.
Configuration	Refers either to the process of setting up the software for a given system or the result of performing this process. The configuration activity includes editing the database, building schematic displays and reports, and defining user calculations. Typically, the software set up of a device that can often be defined and changed. Can also mean the hardware assembly scheme.
Configuration Tree	In ROCLINK 800, the graphical display that appears when a configuration file opens (also *Directory Tree*). It is a hierarchical branching (“tree-style”) method for navigating within the configuration screens.
CPU	Central Processing Unit.
CRC	Cyclical Redundancy Check error checking.
Crosstalk	The amount of signal that crosses over between the receive and transmit pairs, and signal attenuation, which is the amount of signal loss encountered on the Ethernet segment.
CSA	Canadian Standards Association. See http://www.csa.ca.
CSMA/CD	Carrier Sense Multiple Access with Collision Detection.
CTS	Clear to Send modem communications signal.

D

D/A	Digital to Analog signal conversion.
DB	Database.

dB	Decibel. A unit for expressing the ratio of the magnitudes of two electric signals on a logarithmic scale.
DCD	**Data Carrier Detect** modem communications signal. In addition, **Discrete Control Device** – A discrete control device energizes a set of discrete outputs for a given setpoint and matches the desired result against a set of discrete inputs (DI).
DCE	Data Communication Equipment.
Deadband	A value that is an inactive zone above the low limits and below the high limits. The purpose of the deadband is to prevent a value (such as an alarm) from being set and cleared continuously when the input value is oscillating around the specified limit. This also prevents the logs or data storage location from being over-filled with data.
Device Directory	In ROCLINK 800, the graphical display that allows navigation through the PC Comm Ports and ROC Comm Ports set up screen.
DI	Discrete Input.
Discrete	Input or output that is non-continuous, typically representing two levels (such as on/off).
DMM	Digital multimeter.
DO	Discrete Output.
Download	The process of sending data, a file, or a program from a PC to a ROC.
DP	Differential Pressure.
DSR	Data Set Ready modem communications signal.
DTE	Data Terminal Equipment.
DTR	Data Terminal Ready modem communications signal.
Duty Cycle	Proportion of time during a cycle that a device is activated. A short duty cycle conserves power for I/O channels, radios, and so on.
DVM	Digital voltmeter.
DVS	Dual-Variable Sensor. A device that provides static and differential pressure inputs to a ROC.

E

EDS	Electronic Static Discharge.
EEPROM	Electrically Erasable Programmable Read-Only Memory, a form of permanent memory on a ROC.
EFM	Electronic Flow Metering or Measurement.
EIA-232 (RS-232)	Serial Communications Protocol using three or more signal lines, intended for short distances. Concerning RS232D and RS232C, the letters C or D refer to the physical connector type. D specifies the RJ-11 connector where a C specifies a DB25 type connector.
EIA-422 (RS-422)	Serial Communications Protocol using four signal lines.
EIA-485 (RS-485)	Serial Communications Protocol requiring only two signal lines. Can allow up to 32 devices to be connected together in a daisy-chained fashion.
EMF	Electro-Motive Force.
EMI	Electro-Magnetic Interference.
ESD	Electro-Static Discharge.
EU	Engineering Units. Units of measure, such as MCF/DAY.

F

FCC	Federal Communications Commission. See http://www.fcc.gov.

Firmware	Internal software that is factory-loaded into a form of ROM. In a ROC, the firmware supplies the software used for gathering input data, converting raw input data values, storing values, and providing control signals.
FlashPAC module	ROM and RAM module for a ROC300-Series unit that contains the operating system, applications firmware, and communications protocol.
Flash ROM	A type of read-only memory that can be electrically re-programmed. It is a form of permanent memory (requires no backup power). Also called Flash memory.
FloBoss	A microprocess-based device that provides flow calculations, remote monitoring, and remote control. A FloBoss is a type of ROC.
FM	Factory Mutual.
Force	Write an ON/OFF, True/False, or 1/0 value to a coil.
FPV	Compressibility Factor.
FSK	Frequency Shift Keypad.
FST	Function Sequence Table, a type of user-written program in a high-level language designed by Emerson Process Management's Remote Automation Solutions Division.
Ft	Foot or feet.

G

GFA	Ground Fault Analysis.
GND	Electrical ground, such as used by the ROC unit's power supply.
GP	Gauge Pressure.
Gross Quantity	The *indicated quantity times* the *meter factor* derived from a meter proving of the flow meter at a specific flow rate. *Calculation:* gross quantity = indicated quantity *times* meter factor.

H

HART®	Highway Addressable Remote Transducer.
Holding Register	Analog output number value to be read.
Hw	Differential pressure.
Hz	Hertz.

I, J

IC	Integrated Circuit. Also, Industry Canada (more recently known as Measurement Canada), an organization that grants custody transfer approvals on certain ROC units.
ID	Identification.
IEC	Industrial Electrical Code or International Electrotechnical Commission. See http://www.iec.ch.
IEEE	Institute of Electrical and Electronic Engineers. A professional organization that, in conjunction with the International Standards Organization (ISO), establishes and maintains the Open System Interconnection (OSI) reference model and an international standard for the organization of local area networks (LANs). Refer to http://www.ieee.org.
IMV	Integral Multiplier Value, used in AGA3 (orifice) calculations.
Indicated Quantity	The change in the flow meter reading that occurs during a product flow measurement operation. (Not displayed by the DL8000 calculation: indicated quantity = end reading *minus* start reading.)
Input	Digital input, a bit to be read.

Input Register Input numeric value to be read.

I/O Input/Output.

I/O Module Module that plugs into an I/O slot on a ROC to provide an I/O channel.

IP-252 *Institute of Petroleum* standard 252. A British standard for pulse fidelity and security for pulse output type flow meters. Program codes 233 and 234 define the operation of this function.

Note: Equivalent standard is API Manual of Petroleum Measurement Standards / Chapter 5 - Metering /

IRQ Interrupt Request. Hardware address oriented.

ISO International Standards Organization. See http://www.iso.ch.

IV Integral Value.

K

KB Kilobytes.

KHz KiloHertz.

K-factor The pulses per unit quantity generated by a pulse output type flow meter (also *system factor*). The nominal value is determined by flow meter design and factory water flow calibration. The “average” K-factors for the flow meters are usually indicated on the flow meter nameplates.

L

LCD Liquid Crystal Display.

LDP Local Display Panel, a display-only device that plugs into ROC300 (via a parallel interface cable) used to access information stored in the ROC.

LED Light-Emitting Diode.

Load **For sequential blending**: In multi-component blending, a load is the completed delivery of one component of a batch. The completion of loading all components in the batch completes the batch delivery. If the recipe only loads one component, a load corresponds to a batch delivery.

For inline blending: Each component of the blend is loaded simultaneously. Depending on the blend ratio, the low-proportion components are loaded completely during the time that the high proportion component(s) are being loaded. After loading of the highest proportion component has been terminated, all component loads and the batch delivery are complete.

Loading Island Also l*oading rack;* an installation of one or more loading arms or risers used to deliver liquid components to a tanker vehicle located on one or both sides of the island, depending on the design of the island.

Loading Riser The related instruments and devices, located in a meter stream, that provide the liquid component loading capability to a mobile tanker vehicle.

Note: The flow meter piping can also be installed horizontally, if desired.)

Load Spot Also *bay or lane*; one side of a loading island, a position where a tanker vehicle parks for a loading operation. One load spot can have one or more loading arms.

Local Port Also *LOI*; the serial EIA-232 (RS-232) port on the ROC through which local communications are established, typically for configuration software running on a PC.

Logical Number The point number the ROC and ROC Plus protocols use for I/O point types are based on a physical input or output with a terminal location; the point numbers for all other point types are “logical” and are simply numbered in sequence.

LNK Ethernet has linked.

LOI Local Operator Interface (or Local Port). Refers to the serial EIA-232 (RS-232) port on the ROC through which local communications are established, typically for configuration software running on a PC.

LPM Lightning Protection Module; a device that provides lightning and power surge protection for ROCs.

LRC Longitudinal Redundancy Checking error checking.

M

m Meter.

mA Milliamp(s); one thousandth of an ampere.

MAC Address Media Access Control Address; a hardware address that uniquely identifies each node of a network.

Manual mode For a ROC, indicates that the I/O scanning has been disabled.

MAU Medium Attachment Unit.

MCU Master Controller Unit.

Meter Factor A number obtained by dividing the actual volume of liquid passed through a flow meter during a meter proving operation by the volume registered by the flow meter. The meter factor is used in flow calculations to correct the *indicated volume* (end flow meter registration minus start flow meter registration) to the observed *gross volume* (actual flow meter throughput at operating conditions).

Meter factor = (Meter prover volume corrected to standard conditions) ÷ (Flow meter indicated volume corrected to std conditions)

Meter Proving A procedure used to determine the meter factor for a flow meter. The K-factor (exact number of pulses per a volume unit that a flow meter generates) is determined at the factory. The K-factor is used to derive a mathematical factor, known as meter factor, which is used to adjust results of the internal flow calculations the DL8000 performs.

Note: The flow meter is not re-calibrated; determining the meter factor allows the operator to manually re-calibrate the DL8000 so that the flow meter's nonadjustable calibration characteristic [pulses per volume unit (K-factor)] are incorporated into the flow calculations.

Modbus A popular device communications protocol developed by Gould-Modicon.

MPU Micro-Processor Unit.

mm Millimeter.

MMBTU Million British Thermal Units.

msec Millisecond, or 0.001 second.

MVS Multi-Variable Sensor. A device that provides differential pressure, static pressure, and temperature inputs to a ROC for orifice flow calculations.

mV Millivolts, or 0.001 volt.

mW Milliwatts, or 0.001 watt.

N

NEC National Electrical Code.

NEMA National Electrical Manufacturer's Association. See http://www.nema.org.

O

OH Off-Hook modem communications signal.

Off-line Accomplished while the target device is not connected (by a communications link). For example, "off-line configuration" refers to configuring an electronic file that is later loaded into a ROC.

Ohms	Units of electrical resistance.
On-line	Accomplished while connected (by a communications link) to the target device. For example, “on-line configuration” refers to configuring a ROC800-Series unit while connected to it, so that you can view the current parameter values and immediately load new values.
Opcode	Type of message protocol the ROC uses to communicate with the configuration software, as well as host computers with ROC driver software.
Operator Interface	Also LOI or Local Port; the serial EIA-232 (RS-232) port on the ROC through which local communications are established, typically for configuration software running on a PC.
Orifice meter	A meter that records the flow rate of gas through a pipeline. The flow rate is calculated from the pressure differential created by the fluid passing through an orifice of a particular size and other parameters.

P, Q

Parameter	A property of a point that typically can be configured or set. For example, the Point Tag ID is a parameter of an Analog Input point. Parameters are normally edited by using configuration software running on a PC.
PC	Personal Computer.
Permissive	A discrete signal from a device that is input to a discrete input in the DL8000. The DL8000 uses this signal to allow a product delivery to be initiated or allow a product delivery to continue. Permissive contacts are *CLOSED* in the normal or safe state and *OPEN* in the abnormal or unsafe state.
Pf	Flowing pressure.
P/DP	Pressure/Differential Pressure.
PI	Pulse Input.
PID	Proportional, Integral, and Derivative control feedback action.
PIT	Periodic Timer Interrupt.
PLC	Programmable Logic Controller.
Point	Software-oriented term for an I/O channel or some other function, such as a flow calculation. Points are defined by a collection of parameters.
Point Number	The physical location of an I/O point (module slot and channel) as installed in the ROC.
Point Type	Defines the database point to be a specific type of point available to the system. The point type determines the basic functions of a point.
Preset	Number value previously determined for a register. Also: A generic term that describes the functional instrument group to which the DL8000 belongs. The term originated from mechanical and electrical preset counters. The DL8000 provides much more versatility and capability compared to a simple mechanical or electrical preset counter.
PRI	Primary PID control loop.
Primary Blend Stream Component	A blended product measured by a primary blend stream meter.
Primary Blend Stream Meter	A meter measuring the gasoline-ethanol blend.
Protocol	A set of standards that enables communication or file transfers between two computers. Protocol parameters include baud rate, parity, data bits, stop bit, and the type of duplex.

PSTN	Public Switched Telephone Network.
PT	Process Temperature.
PTT	Push-to-Talk signal.
Pulse	Transient variation of a signal whose value is normally constant.
Pulse Interface module	A module that provides line pressure, auxiliary pressure, and pulse counts to a ROC.
PV	Process Variable or Process Value.
Quantity	The resulting amount of product measured after compensation for operational temperature and pressure, indicated in one of the following corrected units: cubic meters, liters, barrels, gallons.

R

Rack	A row of slots on a ROC into which I/O modules can be plugged. Racks are given a letter to physically identify the location of an I/O channel (such as “A” for the first rack). Built-in I/O channels are assigned a rack identifier of “A” while diagnostic I/O channels are considered to be in “E” rack.
RAM	Random Access Memory. RAM is used to store history, data, most user programs, and additional configuration data.
RBX	Report-by-exception. RBX always refers to Spontaneous RBX in which the ROC contacts the host to report an alarm condition.
RR	Results Register; stores the Signal Value Analog (SVA).
Recipe	A pre-entered delivery/blending/control description that allows the DL8000 to automatically control the product quantity or total quantity based on percentages of multiple components during a batch delivery operation. The DL8000 supports up to thirty recipes.
RFI	Radio Frequency Interference.
RI	Ring Indicator modem communications signal.
ROC	Remote Operations Controller microprocessor-based unit that provides remote monitoring and control.
ROCLINK 800	Microsoft® Windows®-based software used to configure functionality in ROC units.
ROM	Read-only memory. Typically used to store firmware. Flash memory.
Rotary Meter	A positive displacement meter used to measure flow rate, also known as a Roots meter.
RTC	Real-Time Clock.
RTD	Resistance Temperature Device.
RTS	Ready to Send modem communications signal.
RTU	Remote Terminal Unit.
RTV	Room Temperature Vulcanizing, typically a sealant or caulk such as silicon rubber.
RS-232	Serial Communications Protocol using three or more signal lines, intended for short distances. Also referred to as the EIA-232 standard.
RS-422	Serial Communications Protocol using four signal lines. Also referred to as the EIA-422 standard.
RS-485	Serial Communications Protocol requiring only two signal lines. Can allow up to 32 devices to be connected together in a daisy-chained fashion. Also referred to as the EIA-485 standard.
RX or RXD	Received Data communications signal.

S

SAMA	Scientific Apparatus Maker's Association.
Script	An uncompiled text file (such as keystrokes for a macro) that a program interprets in order to perform certain functions. Typically, the end user can easily create or edit scripts to customize the software.
Side Stream	The controlled stream, often called the ethanol product. The side stream is metered and can be controlled and measured.
Side Stream Component	A mix component measured by both a side stream meter and a primary blend stream meter. Ethanol is often referred as a side stream component.
Side Stream Meter	A meter that measures the side component (ethanol).
Soft Points	A type of ROC point with generic parameters that can be configured to hold data as desired by the user.
SP	Setpoint, or Static Pressure.
SPI	Slow Pulse Input.
SPK	Speaker.
SRAM	Static Random Access Memory. Stores data as long as power is applied; typically backed up by a lithium battery or supercapacitor.
SRBX	Spontaneous Report-By-Exception. SRBX always refers to Spontaneous RBX in which the ROC contacts the host to report an alarm condition.
Standard Quantity	The *gross quantity* corrected to standard temperature and/or pressure. This is a quantity measurement. *Calculation:* standard quantity = gross quantity *times* CTLM (correction factor for the effect of temperature on the liquid in the meter) *times* CPLM (correction factor for the effect of pressure on the liquid in the meter)
SVA	Signal Value Analog. Stored in the Results Register, it is the analog value that is passed between functions in an FST.
SVD	Signal Value Discrete. Stored in the Compare Flag, it is the discrete value that is passed down the sequence of functions in an FST.
System Variables	Configured parameters that describe the ROC; set using ROCLINK software.

T

T/C	Thermocouple Input.
TCP/IP	Transmission Control Protocol/Internet Protocol.
TDI	Time Duration Input.
TDO	Time Duration Output.
Tf	Flowing temperature.
TLP	Type (of point), Logical (or point) number, and Parameter number.
Transaction	Group of one or more consecutive batch deliveries for accounting purposes. The batches that comprise a transaction always use one recipe, one additive selection, and one loading side. An example of a transaction is the delivery of multiple batches to different compartments in a single tanker vehicle.
Turbine meter	A device used to measure flow rate and other parameters.
TX or TXD	Transmitted Data communications signal.

U

Upload	Send data, a file, or a program from the ROC to a PC or other host.

V-Z

V	Volts.
Volume	The actual space occupied by the product measured, indicated in one of the following actual units: cubic meters, liters, barrels, gallons.
Wild Stream	Wild stream is the uncontrolled stream, often referring to the gasoline product. This is because the gasoline product cannot be exclusively metered, controlled, or measured.
Wild Stream Component	A product component measured as part of (Primary Blend Stream Component – Side Stream Component) a primary blend stream component by a primary blend stream meter is called a wild stream component. Gasoline is referred as wild stream component.

Appendix B – Modbus Communications

This appendix describes how to configure a DL8000 for Modbus communications.

Note: Refer to *Chapter 3, Point Types*, in the *Preset Protocol Specifications Manual* (form A6234) for a discussion of the point types and parameters associated with the DL8000 product.

B.1 Modbus Communications

The DL8000 includes the ability to communicate using the Modbus protocol. This enables you to integrate the DL8000 and Modbus devices into the same host/slave system.

The DL8000 can act either as a slave or a host device.

The Modbus Master mode of operation (enabled on the ROC > Comm Ports screen) allows the DL8000 to simulate a master device that can poll other devices for data and then store that data for parameter updates, for use in FST Registers, user programs, and DS800 programs. The DL8000 can also send commands to set outputs and write data to a slave device. For more information on Modbus master configuration and functionality, refer to *Section A.6, Modbus Master Table*.

In slave mode, the data link between the host device and the DL8000 requires the use of one of the following communications ports:

- Ethernet Port on the CPU.
- EIA-232 (RS-232) Serial Communications Card.
- EIA-485 (RS-485) Serial Communications Card.
- Dial-up Modem Communications Card.

Note: Master mode supports the Comm 2 to Comm 5 communication ports. The LOI and Comm 1 (Ethernet) ports do not support Modbus master mode.

If a serial or modem communications port is configured with a port owner of ROC Plus Protocol/Modbus Slave, the DL8000 automatically determines if the incoming communication request is in ROC protocol or Modbus protocol. The DL8000 responds using the same protocol as the incoming request.

The Ethernet communications port automatically determines if the incoming communication request is in ROC protocol, Modbus RTU encapsulated in TCP/IP, or Modbus TCP/IP protocol. The DL8000 responds using the same protocol as the incoming request.

B.2 Modbus Configuration

From the ROCLINK 800 menu bar, select **Configure** > **MODBUS**. The Modbus Configuration screen displays, showing the General tab (see *Figure B-1*). Use the individual tabs to:

Tab	Use
General	Defines basic communication parameters
Scale Values	Defines up to eight low and high floating point scale values and one low and high integer value for converting floating point numbers to a scaled integer.
Master Table	Simulates Modbus settings.
Master Modem	Configures modems and maps RTU addresses to phone numbers.
Registers	Maps Modbus registers to TLP values using either point indexing or parameter indexing.
History Table	Configures periodic and daily history values.

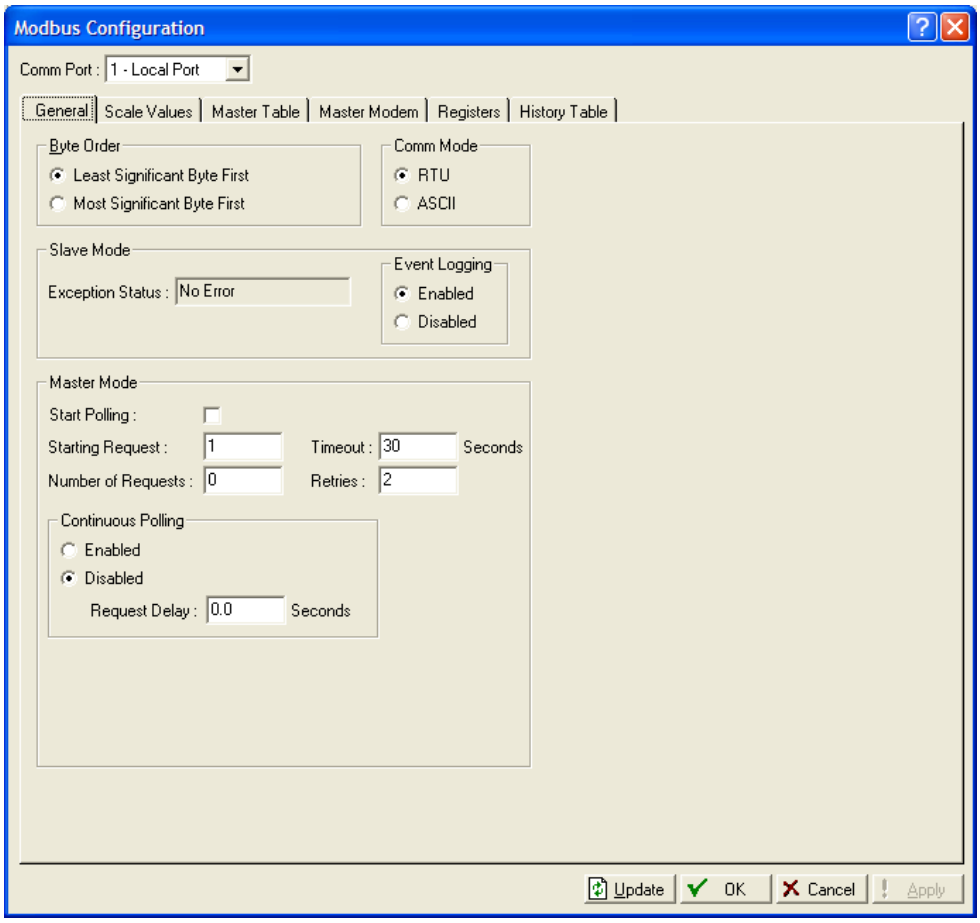

Figure B-1. Modbus Configuration – General Tab

B.2.1 Modbus Configuration General Tab

Complete the following steps to configure the Modbus Configuration screen's General tab.

1. Review the values in the following fields:

Field	Description
Comm Port	Indicates the port to configure. Click ▼ to display additional available ports.
Byte Order	Selects the order of data bytes in a transmission. You can also reverse requests using this selection. **Least Significant Byte First** is the default value. **Note**: This selection affects **only** the Modbus message's data field. It has no effect on the data for Function Codes 01, 02, and 05.
Comm Mode	Indicates the communication mode. Select either **RTU** or **ASCII**. **Note**: In either mode, the transmitting device places the Modbus message into a frame with a known beginning and ending point. See *Tables A-1* and *A-2*.
RTU	Remote Terminal Unit (RTU) mode allows for greater character density and better data throughput than ASCII for the same baud rate. Each message is transmitted in a continuous stream. Data is sent in 8-bit binary characters. RTU mode uses Cyclic Redundancy Check (CRC) error checking. RTU is the **default** value.
ASCII	American Standard Code for Information Interchange (ASCII) mode represents each 8-bit byte of data as two ASCII characters that are the hexadecimal representation of the value. This allows the messages to be read with the use of a dumb terminal, but uses twice as many characters as the RTU mode. Each character sent is composed of a Start bit, 7 or 8 Data bits, and one or two Stop bits with Even, Odd, or No parity. ASCII mode uses Longitudinal Redundancy Checking (LRC) error checking.

Table B-1. RTU Message Framing

Begin of Frame	Address	Function	Data	CRC Error Check	End
T1-T2-T3-T4	1 Byte	1 Byte	N x 1 Byte	2 Bytes	T1-T2-T3-T4

Table B-2. ASCII Message Framing

Begin of Frame	Address	Function	Data	LRC Error Check	End
:	2 Characters	2 Characters	N Characters	2 Characters	CRLF

Field	Description
Slave Mode	This **display-only** field shows the error code for the last received Modbus message. This field is applicable only in slave mode. Valid values are: **0** No Error. **1** Illegal function. **2** Illegal data address. **3** Illegal data value.
Event Logging	Enables the DL8000 to log all parameter changes made through Modbus in the Event log. Valid values are **Enabled** (log all events) or **Disabled** (allow events to be changed but **do not** log those events). The default is **Enabled**.
Start Polling	Starts the Modbus Master polling sequence. Polling begins with the Starting Request entry on the Modbus Master Table and proceeds through the entries in the table. The system resets this check box when the polling sequence completes. **Note**: You must have previously defined Modbus Master as the port owner (select **ROC** > **Comm Ports** > **General** tab).
Starting Request	Defines the starting number (entry) on the Modbus Master Table from which polling begins.
Number of Requests	Indicates the total number of requests in this polling sequence.
Timeout	Indicates, in seconds, the actual amount of time the DL8000 waits to receive a value message after it sends a request to the device. **Note**: **Do not enter zero (0) in this field.**
Retries	Controls the number of times (**in addition to** the initial attempt) the Master DL8000 tries to establish communications with the specified device before reporting a timeout error. Valid values are between **0** and **25**. The default is **2**. **Note**: Use the Timeout field to adjust the amount of time between retries.
Continuous Polling	Indicates whether the system executes the polling sequence continually. Valid values are **Enabled** (the polling sequence executes continually) or **Disabled** (the polling sequence executes only on command). The default is **Disabled**.
Request Delay	Sets, in seconds, a delay between polling request sequences. **Note**: This field is valid **only** if you **enable** Continuous Polling.

2. Click **Apply** to save any changes you have made to this screen.
3. Proceed to *Section B.2.2* to define scale values.

B.2.2 Modbus Configuration Scale Values Tab

Select the Scale Values tab to enter up to eight low and high floating point scale values and one low and high integer values for converting floating point numbers to a scaled integer.

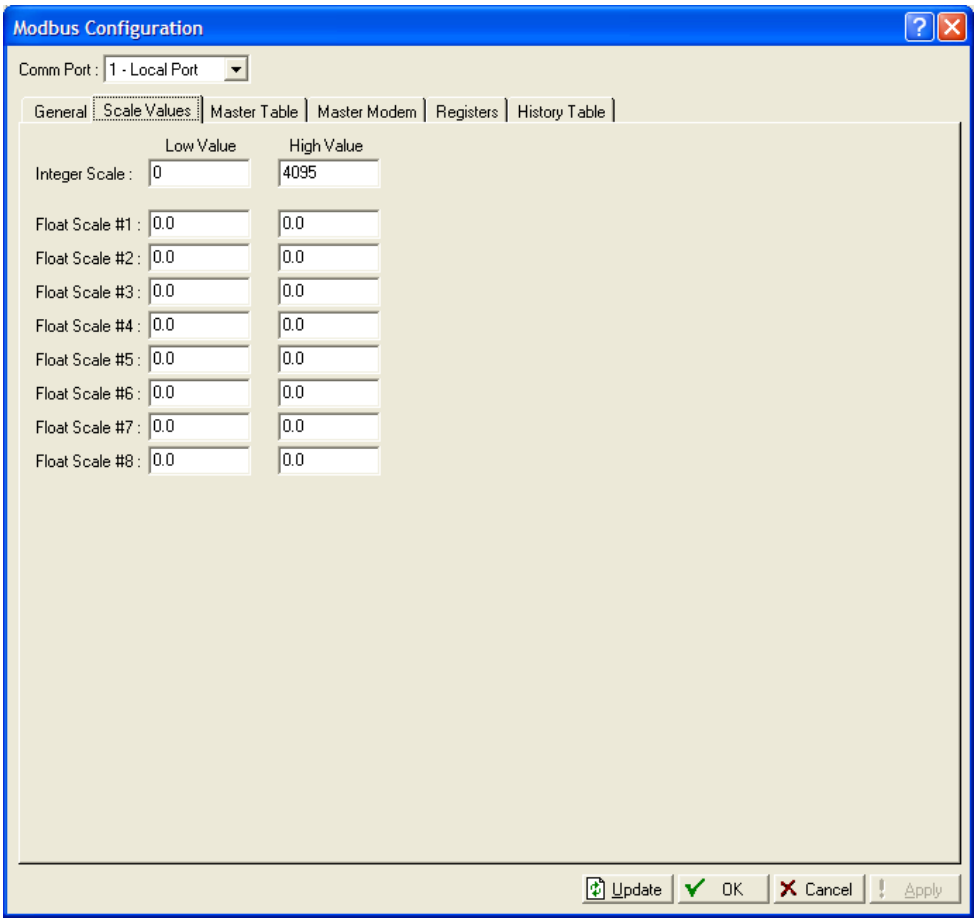

Figure B-2. Modbus Configuration – Scale Values Tab

Scale

Since each I/O point may have different scaling (or calibration), you use the Integer Scale's Low Value and High Value fields to normalize the raw values from the analog I/O points.

The Low Value and High Values fields are signed integers, and can range from –32768 to 32767. You can also use these data fields to scale the analog I/O to integer values with an implied decimal point.

For example, all analog I/O raw values can be transmitted with 0 to 1000 values (0 to 100.0, decimal point implied) by entering **0** in the Low Value field and **1000** in the High Value field. This scaling is used

only on analog I/O specified by the I/O: AI raw A/D input (Type 3, Parameter 17) and AO raw D/A output (Type 4, Parameter 17).

Float In host systems that do not accept floating point numbers, you can specific up to eight sets of floating point ranges. This enables the host to read and set floating point values (such as PID setpoints) as integer values.

Note: The system converts the floating point values according to a register or range of values you set in the Conversion field of the Modbus Registers screen (**Configure** > **MODBUS** > **Registers**). See *Figure B-4*.

Equations The system uses the following equations to convert **floating point values to integers**:

Float Range = High Value Float Scale – Low Value Float Scale

Integer Range = High Value Integer Scale – Low Value Integer Scale

Adjusted Reading = Float Reading – Low Value Float Scale

Integer = **Integer Range** x **Adjusted Reading** + Low Value Integer Scale Float Range

The system uses the following equations to convert **integers to floating point values**:

Float Range = High Value Float Scale – Low Value Float Scale

Integer Range = High Value Integer Scale – Low Value Integer Scale

Adjusted Integer = Integer Sent – Low Value Integer Scale

Float Value = **Adjusted Integer** x **Float Range** + Low Value Float Scale Integer Range

Complete the following steps to configure the Scale Value tab for the Modbus Configuration screen.

1. Review the values in the following fields:

Field	Description
Integer Scale, Low Value	Indicates the 0% value for scaling. Valid values are –32768 to 32767.
Integer Scale, High Value	Indicates the 100% value for scaling. Valid values are –32768 to 32767.
Float Scale 1 through 8	Indicates up to eight sets (Low Value and High Value) of floating point ranges the system uses when the host is not able to process floating point numbers.

2. Click **Apply** to save any changes you have made to this screen.
3. Proceed to *Section B.3* to configure Modbus history options.

B.3 Modbus History

Communications functionality in the DL8000 allows you to retrieve the Periodic/Hourly and Daily history values and Event/Alarm records through Modbus Protocol using Function Code 03. Each historical record contains a time and date stamp on all of the history archives or values for which you have configured the Register Number.

The system uses the Modbus Function Code 03 and the History Archive Register to collect the archived data. Two separate Modbus registers indicate the current Hourly and Daily history index. You configure these on the Modbus Registers screen as the Hourly History Index Register and the Daily History Index Register for the segment being referenced (subtract 1 to get the last archived values). These indexes identify the current history archive at which data is to be logged.

When the DL8000 receives a Function Code 03 request referencing the Periodic History Index (commonly register 7161) or Daily History Index (commonly register 7160), the host interprets the value returned as an index into the specified history log. The host reads the indexes and then compares the index to the last polled history index (which the host maintains) to decide whether to request history.

If the host decides to request history, the reply message contains the date and time stamp and historical values configured for the specified register for that index.

For the DL8000, the response message contains two floating point values for the time and date stamp of the history archive (time stamp = HHMM and date stamp = MMDDYY) and floating point values for each of the defined history points for that History Archive Register. The history date stamp uses the current year and **does not** figure the number of years since 1980. For example, if the current year is 2007, the year (YY) for the date stamp would be **07**. The DL8000 maps history collection on the Modbus History Table.

Table B-3 summarizes the function calls and their associated register and data fields.

Table B-3. Modbus History, Event, and Alarm Functionality

Function Code	Register Field	Data Field	Description
03	32 - Event/Alarm Register	Ignored[1]	Response contains Event and Alarm records[2]. Maximum number of bytes returned is 240 (12 records of 20 bytes each). Events are returned before Alarms are returned. See *Table A-4* for the displayed format.
05	32 - Event/Alarm Register	Ignored	After Events and Alarms have been returned, an acknowledgment occurs so that the same Events and Alarms are not returned on the next request.

Function Code	Register Field	Data Field	Description
03	703 - Daily History	Daily History Archive Register Index (0 to 34)	Response contains two floating point values for the time and date stamp of the history archive (time stamp = HHMMSS and date stamp = MMDDYY) and floating point values for each of the defined history points for that History Archive Register.
03	704 - Hourly History	Hourly or Periodic History Archive Register Index (0 to 839)	Response contains two floating point values for the time and date stamp of the history archive (time stamp = HHMMSS and date stamp = MMDDYY) and floating point values for each of the defined history points for that History Archive Register.

[1]The Periodic Index, Daily Index, and Event/Alarm data fields address a history index number.

[2]The Event and Alarm Log record consists of the bytes shown in *Table A-4*. *Table A-5* provides a breakdown of the bit map in bytes 1-2.

B.3.1 Modbus Configuration History Table Tab

The Modbus History Table allows you to configure the Periodic and Daily history values and Event/Alarm records for retrieval through Modbus Protocol, using Function Code 03. You define three registers to retrieve the current date in the DL8000, the current time in the DL8000, and Event/Alarm records. You can also use the Modbus History Table to define the Periodic and Daily registers for up to twenty groups of history points.

Note: Before configuring the Modbus History, be sure to completely configure the History Segment and History Point.

To access this screen:

1. Select **Configure** > **MODBUS**. The Modbus Configuration screen displays.
2. Select the **History Table** tab. The Modbus History Table displays.

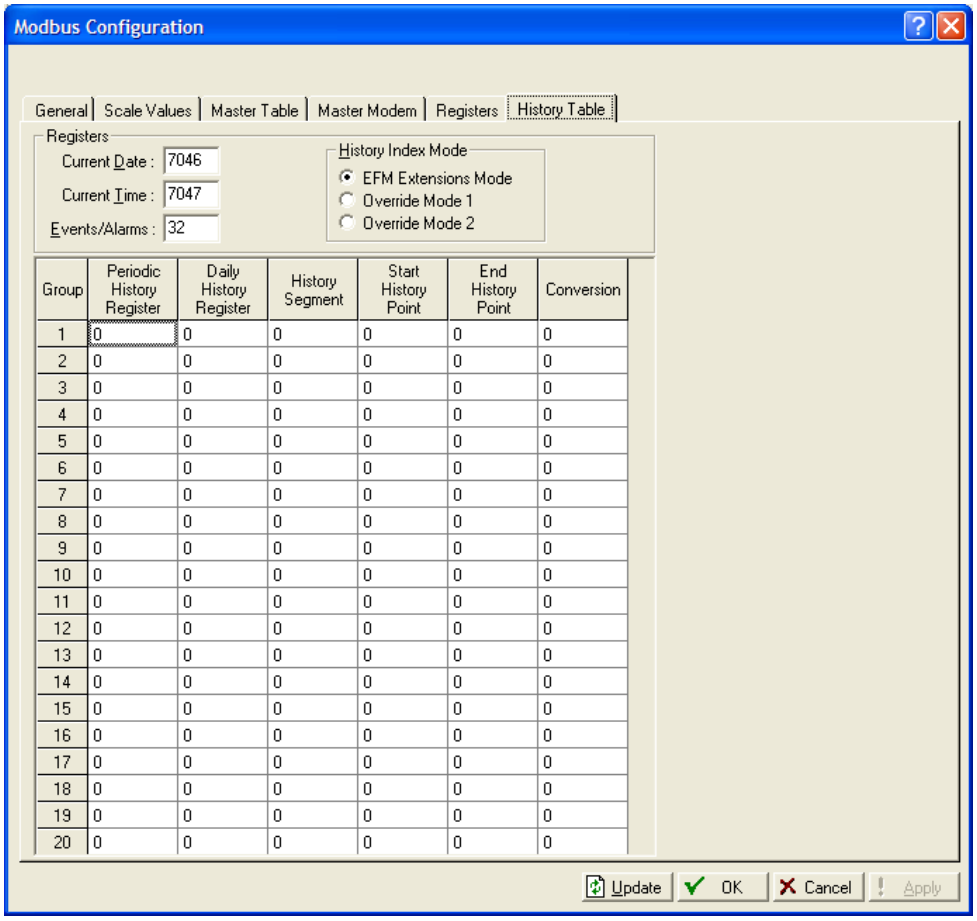

Figure B-3. Modbus Configuration - History Table Tab

3. Review the values in the following fields:

Field	Description	
Registers	Indicates the specific Modbus register numbers the system uses to acquire the Current Date (default of **7046**), the Current Time (default of **7047**), and the Events/Alarms log (default **32**). The Current Date and Current Time values identify the current date and time on the DL8000 and are most useful if you want the date and time as floating point numbers in the format DDMMYY and HHMM. **Note**: Although you can define other values for these registers, it is strongly suggested you use the default values.	
History Index Mode	Indicates how the system handles requests for history records from the history index. Valid values are:	
	EFM Extensions Mode	Returns the history index as **one less** than the value of the internal history index and returns history data for the index requested.
	Override Mode 1	Returns the history index as the

Field	Description	
		value of the internal history index and returns history data as **one less** than the index requested.
	Override Mode 2	Returns the history index as the **one less** than the value of the internal history index and returns history data for the last valid index if the request is equal to or exceeds the number of requested records.
	Note: Contact technical support personnel to validate how your host requests history index information.	
Group	Identifies a contiguous group of history points from a single segment whose values the DL8000 can access through a Modbus Function Code 03 request for a user-defined Modbus register. You can define up to 20 groups. **Note**: *Figure A-3* shows a history table with the first group configured for daily and period history registers.	
Period History Register	Indicates the Modbus register number the DL8000 uses to acquire the group of periodic history points defined in the Start History Point and End History Point fields. The typical value for this register is **704**; you can define other values if necessary. **Note**: Use the Periodic Sample Rate field on the History Segment Configuration screen (**Configure** > **History Segments** on the ROCLINK 800 menu bar) to define the sampling frequency. For example, if you enter **60** in the Periodic Sample Rate field, this is hourly history.	
Daily History Register	Indicates the Modbus register number the DL8000 uses to acquire the group of periodic history points defined in the Start History Point and End History Point fields. The typical value for this register is **703**; you can define other values if necessary.	
History Segment	Indicates the segment from which the DL8000 acquires history. In this example, 0 is the General Segment. **Note**: You must configure any segment you enter on the History Segment Configuration screen (**Configure** > **History Segments** on the ROCLINK 800 menu bar).	
Start History Point	Identifies the first history point the DL8000 retrieves.	
End History Point	Identifies the last history point the DL8000 retrieves. This value must be greater than or equal to the value you enter in the Start History Point field.	

Field	Description
Conversion	Indicates the type of conversion, if required, for the data. By default, the system returns these values as floating point numbers. See *Table A-6* for a listing of convert codes.

4. Click **Apply** to save any changes you have made to this screen.
5. Proceed to *Section A.4* to configure Modbus events and alarms.

B.4 Modbus Events & Alarms Functionality

The Event Log and Alarm Log have the same sized record format and similar contents. The first word in a record is a bit map in which bit 9 indicates if the log record is an event (1) or an alarm (0). The meanings of the other bits are specific to either the Event or the Alarm Log records. See *Table B-5*.

The DL8000 supports Modbus with EFM extensions method for retrieving alarms and events. When the DL8000 receives a Function Code 03 request referencing defined Events/Alarms Register (usually 32), the DL8000 begins to collect records from first the Event Log and then the Alarm Log, starting where the last poll left off. The DL8000 then collects records until **either** there are no more new events/alarms **or** the maximum of twelve records have been collected. The DL8000 sends the information back to the host, which in return replies with Function Code 05, referencing the same Events/Alarms Register and indicating that the points have been received and that the host is ready for the next twelve records.

B.4.1 Reading Events & Alarms Register

The Modbus request to read the Event & Alarm Log uses the standard read Function Code 03. In this request, the number of registers is included to maintain format compatibility but is ignored by the receiving DL8000.

For the date stamp in the events and alarms returned, the year (YY) is really the number of years since 1980 (for example, if the current year is 2007, the year (YY) for the date stamp would be 27).

B.4.2 Acknowledging Events & Alarms

The Modbus request to acknowledge the Event\Alarm Log uses Function Code 05. For this request, the DL8000 always uses only one register.

Table B-4. Modbus Events and Alarms Log Contents

Byte	Contents of Event Log Record	Contents of Alarm Log Record
1-2	Operator change (Event Log) bit map (16-bit integer). See *Table B-5.*	Alarm change bit map (16-bit integer). See *Table B-5*.
3-4	Modbus register number of variable (16-bit integer)	Modbus register number of variable (16-bit integer)
5-8	Time Stamp (HHMMSS; 32-bit floating point)	Time Stamp (HHMMSS; 32-bit floating point)
9-12	Date Stamp (MMDDYY; 32-bit floating point)	Date Stamp (MMDDYY; 32-bit floating point)
13-16	Previous value of variable (32-bit floating point)	Current (alarmed) value of variable (32-bit floating point)
17-20	Current (New) value of variable (32-bit floating point)	Unused at the current time (zero-filled when transmitted to the master)

Table B-5. Events and Alarm Change Bit Map Contents

Bit	Operator Change Bit Map	Alarm Change Bit Map
0	Fixed value - change to an EU value on an I/O point in Manual Mode	Not Used
1	Zero scale - change to the 0% Adjusted on an AO or AI	Not Used
2	Full scale - change to the 100% Adjusted on an AO or AI	Not Used
3	Operator entry work value - change to any parameter other than those described	Not Used
4	Boolean fixed bit - change to Status in DO or DI	Not Used
5	Fixed/variable flag - change to Manual Mode for an I/O point	Manual alarm
6	Table entry change - change to Modbus Function Tables	Status Change alarm
7	System command change - events logged by system (Power up)	No Flow alarm
8	Not Used	Point Fail alarm
9	Operator change (Event Log) or Alarm identifier bit	Event or alarm identifier bit
10	Low Low Limit - change to Low Low Alarm parameter	Low Low alarm
11	Low Limit - change to Low Alarm parameter	Low alarm
12	High Limit - change to High Alarm parameter	High alarm
13	High High Limit - change to High High Alarm parameter	High High alarm
14	Rate of Change Limit - change to Rate Alarm parameter	Rate alarm
15	Not Used	Set/clear alarm (1 = set, 0 = clear)

B.5 Modbus Registers

Modbus Register tables allow you to map Modbus registers to Point Type, Logical, and Parameter (TLP) numbers. Using either Point Indexing or Parameter Indexing, you can map more than one line in the Modbus Register table to more than one register-to-TLP pair.

- In point indexing, you map the Start Register to the selected TLP. You then map subsequent registers (through the End Register) to the

same **point type** and **parameter** and increment the point **logical** number.

- In parameter indexing, you map the Start Register to the selected TLP. You then map subsequent registers (through the End Register) to the same **point type** and **point logical number**, and increment the **parameter** number.

Once you map a register, any Modbus request can reference it, provided the TLP's data type is appropriate for the function code.

Notes:

- If the native DL8000 data type does not meet the requirements of the Modbus host device, conversion codes are available to convert the data to the required data type. Contact technical support personnel.
- You can select to have the mapping apply to all communication ports or only a selected port.

When the DL8000 receives a Modbus request, it searches for the referenced register(s). If the DL8000 finds a register number match, it builds a response based on the device point type and parameter configured in the table. If the DL8000 cannot locate a register number match, it returns an error message.

To access the Modbus Registers screen, select **Configure** > **MODBUS** > **Registers** tab. The Modbus Register screen displays (see *Figure B-4*).

The screen provides up to 24 register tables, each containing 15 table entries. For each table entry, you can define multiple register using either point indexing or parameter indexing.

Note: The DL8000 has **no** default values for the Modbus Register.

By making the registers continuous (that is, the Start Register address of a new line is **one greater** than the End Register address of the previous line), you can create a continuous data table for Modbus Function 3, 4, or 16, up to the limit of 240 bytes. This type of data table allows you to access all its data with a single request.

Map Periodic or Daily History index registers to the TLP for the Periodic Index (Point Type 124, Parameter 5) or Daily Index (Point Type 124, Parameter 6). In this TLP, the Logical number is the History Segment number. Remember to create an index for each History Segment from which you need to request history.

B.5.1 Modbus Configuration Registers Tab

To access this screen:

1. Select **Configure** > **MODBUS**. The Modbus Configuration screen displays.
2. Select the **Registers** tab. The Modbus Registers screen displays.

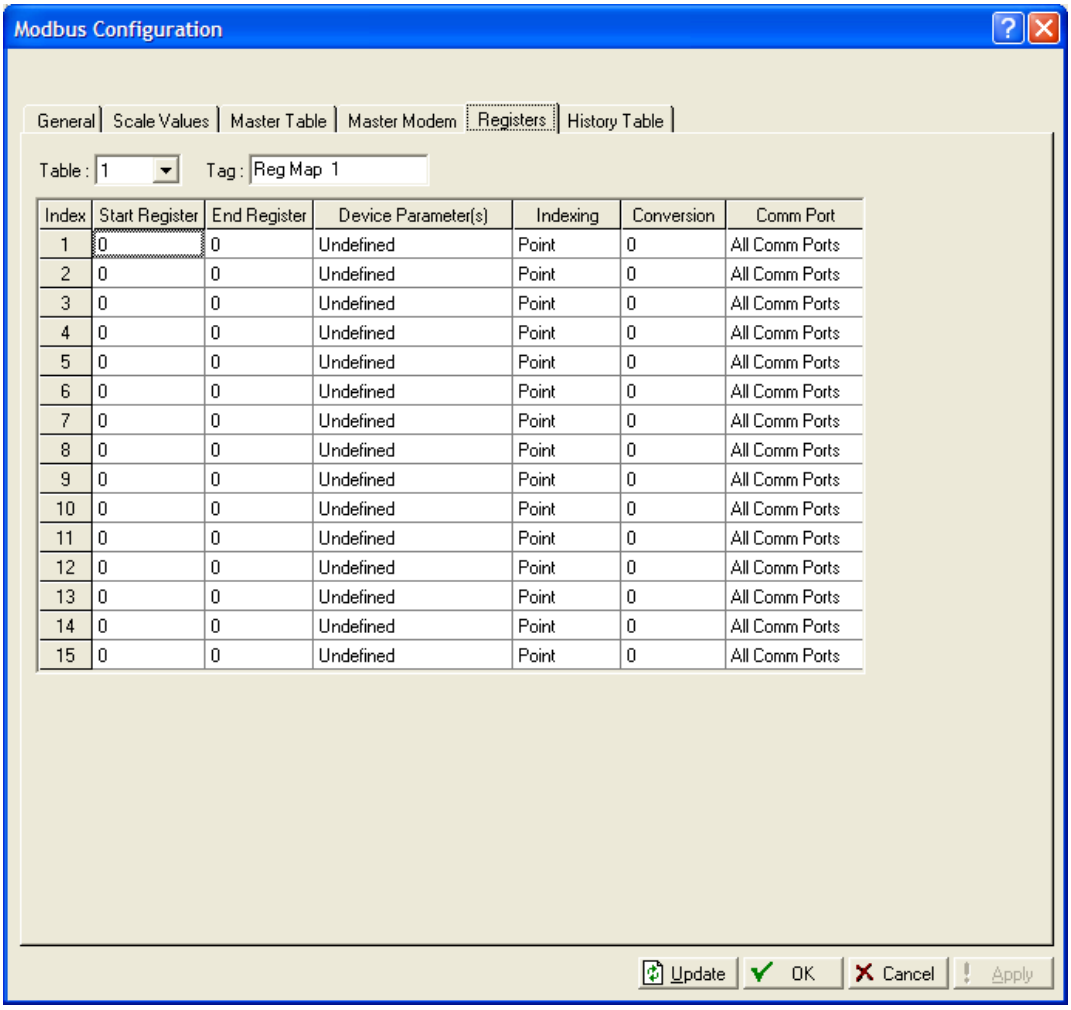
Modbus Configuration
General
Scale Values
Master Table
Master Modem
Registers
History Table
Table : 1
Tag : Reg Map 1
Index | Start Register | End Register | Device Parameter(s) | Indexing | Conversion | Comm Port
1 | 0 | 0 | Undefined | Point | 0 | All Comm Ports
2 | 0 | 0 | Undefined | Point | 0 | All Comm Ports
3 | 0 | 0 | Undefined | Point | 0 | All Comm Ports
4 | 0 | 0 | Undefined | Point | 0 | All Comm Ports
5 | 0 | 0 | Undefined | Point | 0 | All Comm Ports
6 | 0 | 0 | Undefined | Point | 0 | All Comm Ports
7 | 0 | 0 | Undefined | Point | 0 | All Comm Ports
8 | 0 | 0 | Undefined | Point | 0 | All Comm Ports
9 | 0 | 0 | Undefined | Point | 0 | All Comm Ports
10 | 0 | 0 | Undefined | Point | 0 | All Comm Ports
11 | 0 | 0 | Undefined | Point | 0 | All Comm Ports
12 | 0 | 0 | Undefined | Point | 0 | All Comm Ports
13 | 0 | 0 | Undefined | Point | 0 | All Comm Ports
14 | 0 | 0 | Undefined | Point | 0 | All Comm Ports
15 | 0 | 0 | Undefined | Point | 0 | All Comm Ports
Update
OK
Cancel
Apply

Figure B-4: Modbus Configuration – Registers Tab

3. Review the values in the following fields:

Field	Description
Table	Indicates the table to which you are mapping registers. Click ▼ to display additional tables (up to 24).
Tag	Indicates a label associated with the table number. Enter up to 10 alphanumeric characters. The system uses this value on other displays.
Index	Identifies the line number for this register entry.

Field	Description	
Start Register	Indicates the first data register in the address span. Valid values are **0** to **65535**. You can duplicate register numbers as long as you assign them to separate (unique) communication ports. Number tables from smallest to largest. **Note**: Certain Modbus host devices transmit the register 40101 as **100**. In those cases, place **100** in this field, since the DL8000 uses the actual host-send value. For example, a host device requests start register 500 through end register 700. You define the start register as 400 and the end register as 700. All the registers the host requests (500 through 700) are valid and would be answered because the requested register number match or fall between the defined start and end register numbers (400 and 700, respectively).	
End Register	Indicates the last data register in the address span. Determine this value by adding the total number of defined registers to the number of the start register and then subtracting one. For example, if you define a total of 120 registers and the first data register is 6, the value for this field is 125 (120+6-1=125).	
Device Parameter(s)	Indicates the type of data associated with an address (composed of the start register through the end register). Click the field to display the TLP button (**…**) to set parameters.	
Indexing	Indicates the type of indexing. Valid values are **Point** or **Parameter**. The default is **Point**.	
	Point	Start register is mapped to the selected device parameter. Subsequent registers (through the end register) are mapped to the same point type and parameter and increment the **Logical** number.
	Parameter	Start register is mapped to the selected device parameter. Subsequent registers (through the end register) are mapped to the same point type and point logical number, and increment the **Parameter** number.
	Note: Indexing allows you to define a block of register values as successive logical point numbers or parameters without defining each register value separately.	

Point Indexing Example

When using **Point Indexing** the configuration of

Starting Register	Ending Register	Device Parameter(s)	Indexing	Conversion
100	103	AIN, 4-1, EU	Point	0

specifies four registers (100, 101, 102, and 103) that are mapped to a group of analog input (AIN) values in engineering units (EU) starting at the analog input in the fourth module location, first position (4-1):

- Register 100 = EU of AIN point in location 4-1.
- Register 101 = EU of AIN point in location 4-2.
- Register 102 = EU of AIN point in location 4-3.
- Register 103 = EU of AIN point in location 4-4.

Parameter Indexing Example

When using **Parameter Indexing** the configuration of

Starting Register	Ending Register	Device Parameter(s)	Indexing	Conversion
109	114	FST 1, R1	Parameter	1

specifies six registers (109, 110, 111, 112, 113, and 114) that are mapped to a group of FST 1 parameters starting at FST Register 1:

- Register 109 = Register 1 of FST Point Number 1.
- Register 110 = Register 2 of FST Point Number 1.
- Register 111 = Register 3 of FST Point Number 1.
- Register 112 = Register 4 of FST Point Number 1.
- Register 113 = Register 5 of FST Point Number 1.
- Register 114 = Register 6 of FST Point Number 1.

Conversion Code 1 (Float to Integer, Float Scale 1) converts the floating point value to an integer before returning the response message to the host.

Field	Description
Conversion	Indicates the type of data conversion (if any) required before the data is either sent to the host or written to the DL8000. Conversions accommodate differences in data types between slave and master devices. See *Table B-6*. **Note**: Conversion codes affect Function Codes 3, 4, 6, 8, and 16.

Field	Description
Comm Port	Indicates the communication port associated with this entry. Click the field to display all valid options. Register number must be unique for any given communications port. You can duplicate registers, as long as you assign them to separate ports. If a register number is duplicated within a port, the system uses the first occurrence of the register.

4. Click **Apply** to save any changes you have made to this screen.
5. Proceed to *Section B.5.2* to configure Modbus conversions.

B.5.2 Modbus Conversion

Conversion codes convert data into a format that is compatible with a Modbus device.

You use the Conversion field (present on both the Modbus Registers and the Modbus History screens) to specify the type of conversion required, if any, on the data before it is sent to the host or before it is written to the DL8000. The conversions are used to account for differences in data types between the master and slave devices.

Conversion codes 65 to 72 allow a 4-byte IEEE formatted floating point number to be sent or received in two Modbus registers with the byte orders configurable. ROCLINK 800 checks to ensure that an even number of registers is requested, that the Start Register number does not begin in the middle of a register pair, and that the number of registers does not exceed the number of registers configured.

Table B-6. Modbus Conversion Codes

Convert Code	Description	Slave Function	Definition
0	No Conversion		
1	Float to integer, Float Scale 1	3,4	The Float to Integer conversion changes DL8000 floating point data to an integer for transmission to the host. The number of the Convert Code specifies which floating point scaling value is to be used for the conversion.
2	Float to integer, Float Scale 2	3,4	
3	Float to integer, Float Scale 3	3,4	
4	Float to integer, Float Scale 4	3,4	
5	Float to integer, Float Scale 5	3,4	
6	Float to integer, Float Scale 6	3,4	
7	Float to integer, Float Scale 7	3,4	
8	Float to integer, Float Scale 8	3,4	
9 to 16	No Conversion	6,16	
25	Any type to Float, No Scaling	3,4,6,16	When using Function Code 03 or 04, this conversion changes any data type (unsigned or signed Character, Integer, or Long) in the DL8000
26	Any type to Signed Short Integer	3,4,6,16	

Convert Code	Description	Slave Function	Definition
27	Any type to Signed Long Integer	3,4,6,16	to a specific point value for transmission to the host. When using Function Code 6 or 16, this conversion changes a transmitted floating point value to the correct data type for the DL8000 TLP.
28	Any type to Unsigned Short Integer	3,4,6,16	
29	Any type to Unsigned Long Integer	3,4,6,16	
30 to 32	No Conversion		
48	No Conversion	N/A	N/A
57 to 64	No Conversion	N/A	N/A
65	IEEE Floating Point Number	3,4,16	Code 65 places byte 0 and byte 1 in register xxxxx; byte 2 and byte 3 are placed in register xxxxx + 1. This places a 4-byte floating point value into two, 2-byte registers to allow integer values to be transmitted. Code 66 does the same as Code 65 regardless of the value in the Byte Order field in the Modbus Configuration screen.
66	IEEE Floating Point Number	3,4,16	Register xxxxx byte 0, byte 1 Register xxxxx + 1 byte 2, byte 3
67	IEEE Floating Point Number	3,4,16	Code 67 reverses byte 0 and byte 1 order in register xxxxx; reverses byte 2 and byte 3 order in register xxxxx + 1. This places a 4-byte floating point value into two, 2-byte registers to allow integer values to be transmitted. Code 68 does the same as Code 67 regardless of the value in the Byte Order field in the Modbus Configuration screen.
68	IEEE Floating Point Number	3,4,16	Register xxxxx byte 1, byte 0 Register xxxxx + 1 byte 3, byte 2
69	IEEE Floating Point Number	3,4,16	Code 69 places byte 2 and byte 3 in register xxxxx; byte 0 and byte 1 are placed in register xxxxx + 1. This places a 4-byte floating point value into two, 2-byte registers to allow integer values to be transmitted. Code 70 does the same as Code 69 regardless of the value in the Byte Order field in the Modbus Configuration screen.
70	IEEE Floating Point Number	3,4,16	Register xxxxx byte 2, byte 3 Register xxxxx + 1 byte 0, byte 1
71	IEEE Floating Point Number	3,4,16	Code 71 reverses byte 2 and byte 3 order in register xxxxx; reverses byte 0 and byte 1 order in register xxxxx + 1. This places a 4-byte floating point value into two, 2-byte registers to allow integer values to be transmitted. Code 72 does the same as Code 71 regardless of the value in the Byte Order field in the Modbus Configuration screen.
72	IEEE Floating Point Number	3,4,16	Register xxxxx byte 3, byte 2 Register xxxxx + 1 byte 1, byte 0
75 to 255	No Conversion	N/A	N/A

B.6 Modbus Master Table

The Modbus Master mode allows the DL8000 to simulate a master device that can poll other devices for data and to store the data for parameter updates, for use in FST program registers. The DL8000 can also send commands to set outputs and write data to a slave device.

Note: You can configure Modbus master functionality **only** for the EIA-232 (RS-232), EIA-485 (RS-485), and modem communications ports (Comm 2 through Comm 5). The LOI and Ethernet (Comm 1) ports **do not** support Modbus master communications.

You can configure up to 200 different master requests/commands across communication ports Comm 2 through Comm 5. Each command can transmit or receive up to 240 bytes of data.

The system supports Modbus Function Codes 1, 2, 3, 4, 5, 6, 15, and 16. Function Codes 1 to 4 request data **from** slave devices, while codes 5, 6, 15, and 16 transmit data **to** a slave device. *See Table B-7.*

Table B-7. Modbus Function Codes

Code	Meaning	Action
01	Read Logic Coil Status	Obtain current status (ON/OFF) of a group of logic coils (outputs).
02	Read Discrete Input Status	Obtain current status (ON/OFF) of a group of Discrete Inputs.
03	Read Output Registers (Holding)	Obtain current binary value in one or more holding registers.
04	Read Input Registers	Obtain current binary value in one or more input registers.
05	Force Single Logic Coil	Force logic coil to a state of ON or OFF. Acknowledge Alarm or Event request.
06	Preset Single Holding Register	Place a specific binary value into a holding register.
15	Force Multiple Logic Coils	Force a series of consecutive logic output coils to defined ON or OFF states.
16	Preset Multiple Holding Registers	Place specific binary values into a series of consecutive holding registers.

Each master request you configure must have a corresponding entry in the Modbus Registers table. When using Modbus Function Codes 1 to 4, the DL8000 reads data **from** a slave device and writes it **to** the TLP specified in the Modbus Registers table. When using Modbus Function Codes 5, 6, 15, and 16, the DL8000 reads data **from** the TLP specified in the Modbus Registers table and writes it **to** the slave device.

As a Modbus master, the DL8000 may have to communicate to multiple slave devices through modems and phone lines. The Modbus Master Modem screen provides the necessary parameters to configure the modems and map RTU Addresses to phone numbers. One communication port has the ability to dial-up six different Modbus

slaves. The DL8000 will retry three times to establish a connection with a slave.

You can create an FST to schedule Modbus Master requests. The FST must set the Start Polling checkbox on the Modbus Configuration screen's General tab (**Configure** > **MODBUS** > **Configuration**) when being used for Modbus Master communications to initiate a sequence of polling. Using FSTs, the DL8000 can dial other Modbus slave devices at regular intervals.

B.6.1 Modbus Configuration Master Table Tab

To access this screen:

1. Select **Configure** > **MODBUS**. The Modbus Configuration screen displays.
2. Select the **Master Table** tab. The Modbus Master Table screen displays.

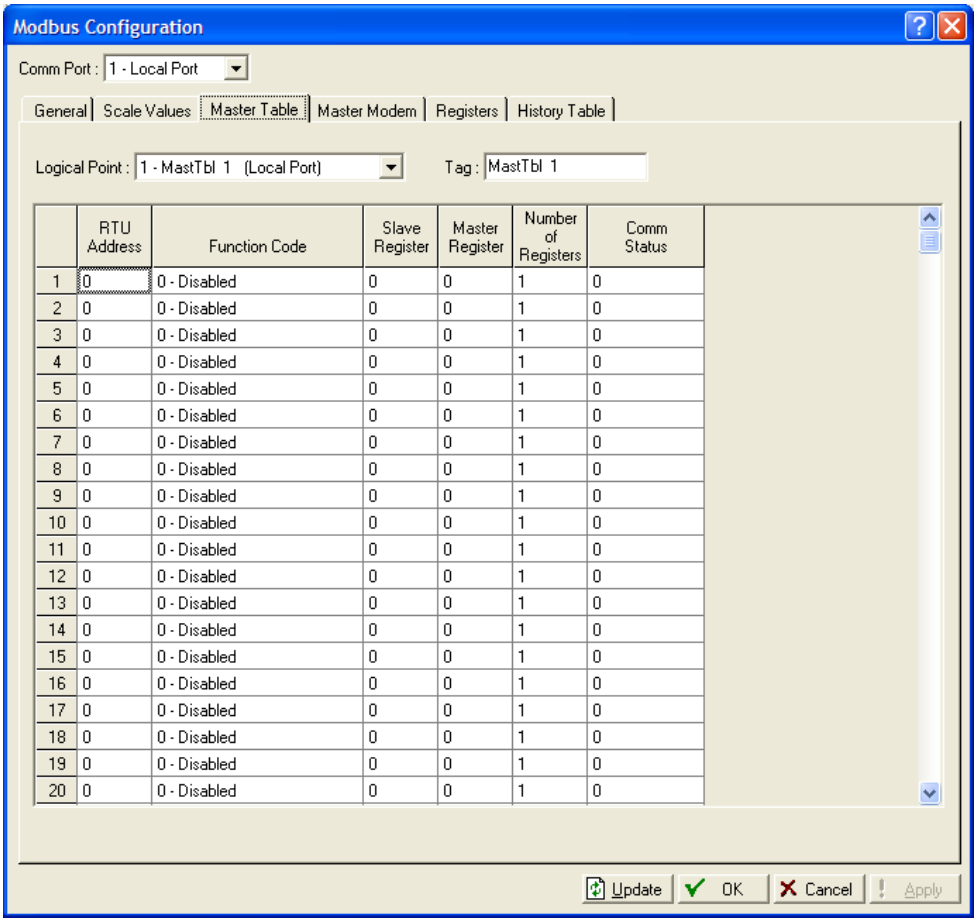
Modbus Configuration
Comm Port : 1 - Local Port
General
Scale Values
Master Table
Master Modem
Registers
History Table
Logical Point : 1 - MastTbl 1 (Local Port)
Tag : MastTbl 1
RTU Address
Function Code
Slave Register
Master Register
Number of Registers
Comm Status
1 0 0 - Disabled 0 0 1 0
2 0 0 - Disabled 0 0 1 0
3 0 0 - Disabled 0 0 1 0
4 0 0 - Disabled 0 0 1 0
5 0 0 - Disabled 0 0 1 0
6 0 0 - Disabled 0 0 1 0
7 0 0 - Disabled 0 0 1 0
8 0 0 - Disabled 0 0 1 0
9 0 0 - Disabled 0 0 1 0
10 0 0 - Disabled 0 0 1 0
11 0 0 - Disabled 0 0 1 0
12 0 0 - Disabled 0 0 1 0
13 0 0 - Disabled 0 0 1 0
14 0 0 - Disabled 0 0 1 0
15 0 0 - Disabled 0 0 1 0
16 0 0 - Disabled 0 0 1 0
17 0 0 - Disabled 0 0 1 0
18 0 0 - Disabled 0 0 1 0
19 0 0 - Disabled 0 0 1 0
20 0 0 - Disabled 0 0 1 0
Update
OK
Cancel
Apply

Figure B-5. Modbus Configuration - Master Table Tab

3. Review the values in the following fields:

Field	Description
Logical Point	Indicates the logical point for the communications port. Click ▼ to display all available logical points.
Tag	Indicates a label associated with the logical point. Enter up to 10 alphanumeric characters.
RTU Address	Indicates the RTU address of the slave device to be queried.
Function Code	Indicates the Modbus function code to be sent to the slave device.
Slave Register	Indicates the starting Modbus register number for the query on this slave device.
Master Register	Indicates the starting Modbus register number where the queried data is stored on the master DL8000 device.
Number of Registers	Indicates the total number of registers in the range.
Comm Status	This **read-only** field shows the status of the query. Valid values include:

0	Inactive or start of transmission.
1	Receive timeout error.
2	Received address check.
3	Received function number check.
4	Number of expected bytes check.
5	Receiving slave response.
6	CRC or LRC check.
7	CRC or LRC check.
8	Valid slave response.
128	Write device data error.
129	Access device data error.
130	Host function table error.
131	Transmit timeout error.
144	Transmit or receive buffer overflow.
145	Invalid function number in request.

4. Click **Apply** to save any changes you have made to this screen.

5. Proceed to *Section B.7* to configure Modbus master modem values.

B.7 Modbus Master Modem

As a Modbus master, the DL8000 may have to communicate with multiple slave devices through modems and phone lines. The Modbus Master Modem screen provides the necessary parameters to configure the modems and map RTU addresses to phone numbers.

Note: You can configure Modbus functionality **only** for communications ports Comm 2 through Comm 5. The LOI and Ethernet (Comm 1) ports **do not** support Modbus master communications.

Each comm port can access to six RTU addresses. This point associates Modbus slave RTU addresses to their respective phone numbers. Up to six different Modbus slaves can be dialed through one communication port. The DL8000 retries three times to establish a connection with a slave.

B.7.1 Modbus Configuration Master Modem Tab

To access this screen:

1. Select **Configure** > **MODBUS**. The Modbus Configuration screen displays.
2. Select the **Master Table** tab. The Master Modem screen displays.

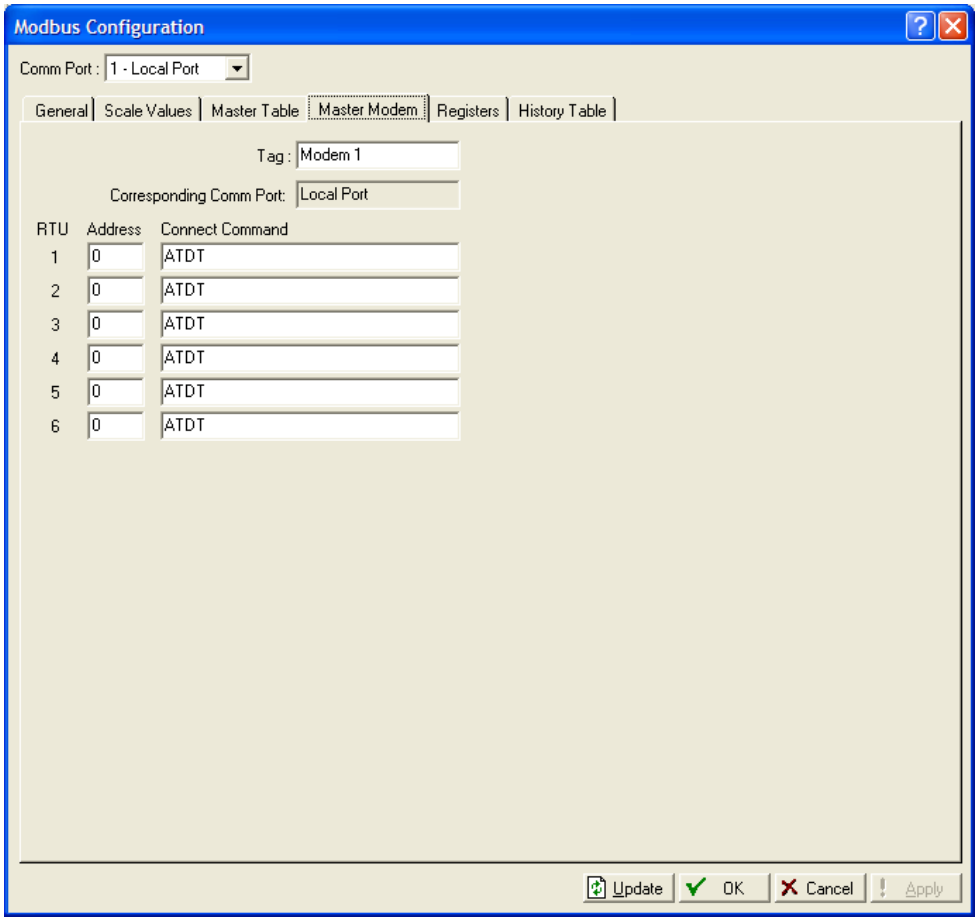

Figure B-6. Modbus Configuration - Master Modem tab

3. Review the values in the following fields:

Field	Description
Comm Port	Indicates the communication port location for hosting. Click ▼ to display all available logical points.
Tag	Indicates a label associated with the communications port. Enter up to 10 alphanumeric characters.
Corresponding Comm Port	This **read-only** field shows the tag defined for the selected communications port.
Address	Provides the RTU address of the slave device to be associated with the connect command. You can dial up to six different Modbus slaves through one communications port.
Connect Command	Indicates the telephone number (connect command) to be sent to the slave device.

4. Click **Apply** to save any changes you have made to this screen.

This completes the process of configuring the DL8000 for Modbus communications.

B.8 HMI Information

This section provides two tables that indicate how the DL8000 monitors batching status via Modbus.

B.8.1 Sequential Blending

Table B-8 lists the monitoring codes for sequential blending in manual mode.

Table B-8. Sequential Blending Status Codes

Status	Status Name
1	Select Recipe
2	Invalid Recipe
3	Enter Preset
4	Invalid Preset
5	Batch Authorized
10	Alarm Batch Halt
12	User Batch Halt
13	Batch Complete
21	Line Pack
22	Wait for Line Pack
23	Flow Control
24	Close Valve
25	Pump Stop Delay
26	Wait for Pump Stop
27	Stop Pump
28	Wait All Stop
29	Batch Halt
30	Next Comp
31	Line Flush
32	End of Batch
33	Wait for Full Valve Close
37	End Batch
38	End Transaction
50	Select Additive
51	Request for Driver ID
53	Request for Aux 1 Data
55	Request for Aux 2 Data
57	Request for Aux 3 Data

Status	Status Name
59	Request for Aux 4 Data
60	Archive Transaction

B.8.2 Ratio Blending

Table B-9 lists the monitoring codes for ratio blending in manual mode.

Table B-9. Ratio Blending Status Codes

Status	Status Name
1	Select Recipe
2	Invalid Recipe
3	Enter Preset
4	Invalid Preset
5	Batch Authorized
10	Alarm Batch Halt
12	User Batch Halt
13	Batch Complete
20	Start Pump
21	Line Pack
22	Wait for Line Pack
23	Flow Control
24	Close Valve
25	Pump Stop Delay
26	Wait for Pump Stop
27	Stop Pump
28	Wait All Stop
29	Batch Halt
31	Line Flush
32	End of Batch
33	Wait for Full Valve Close
37	End Batch
38	End Transaction
50	Select Additive
60	Archive Transaction

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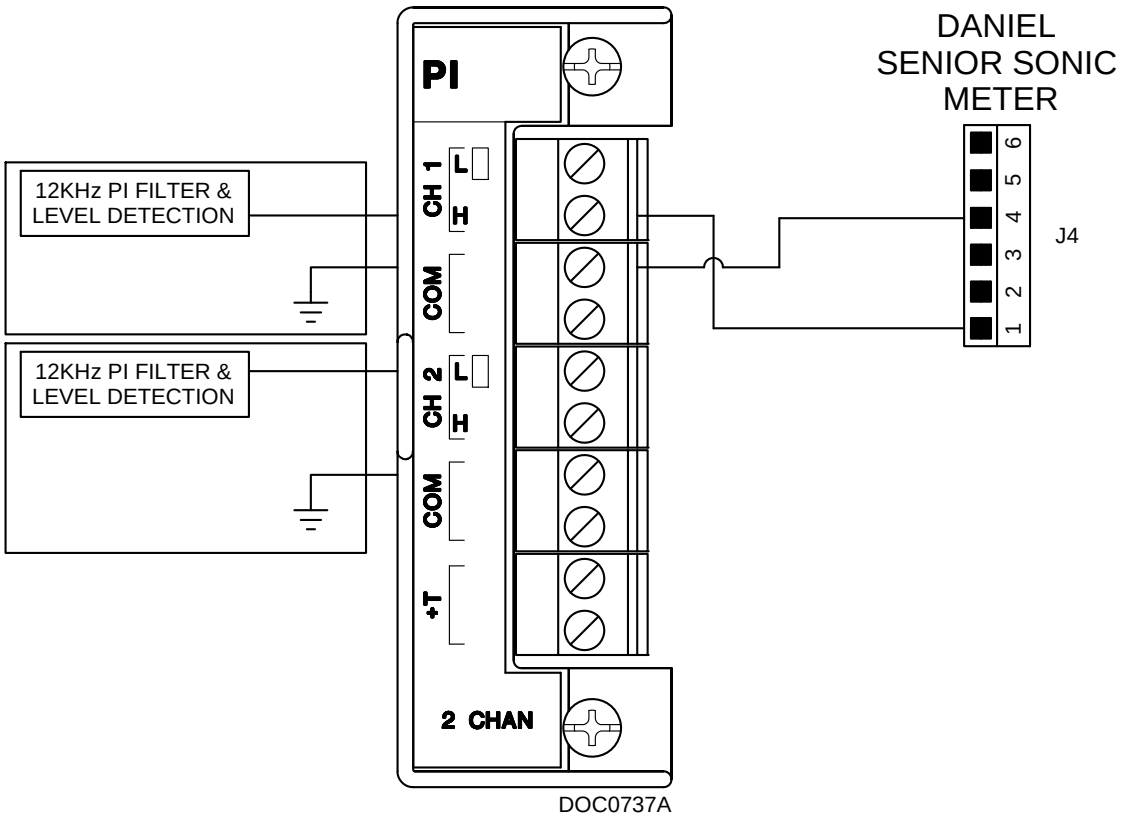
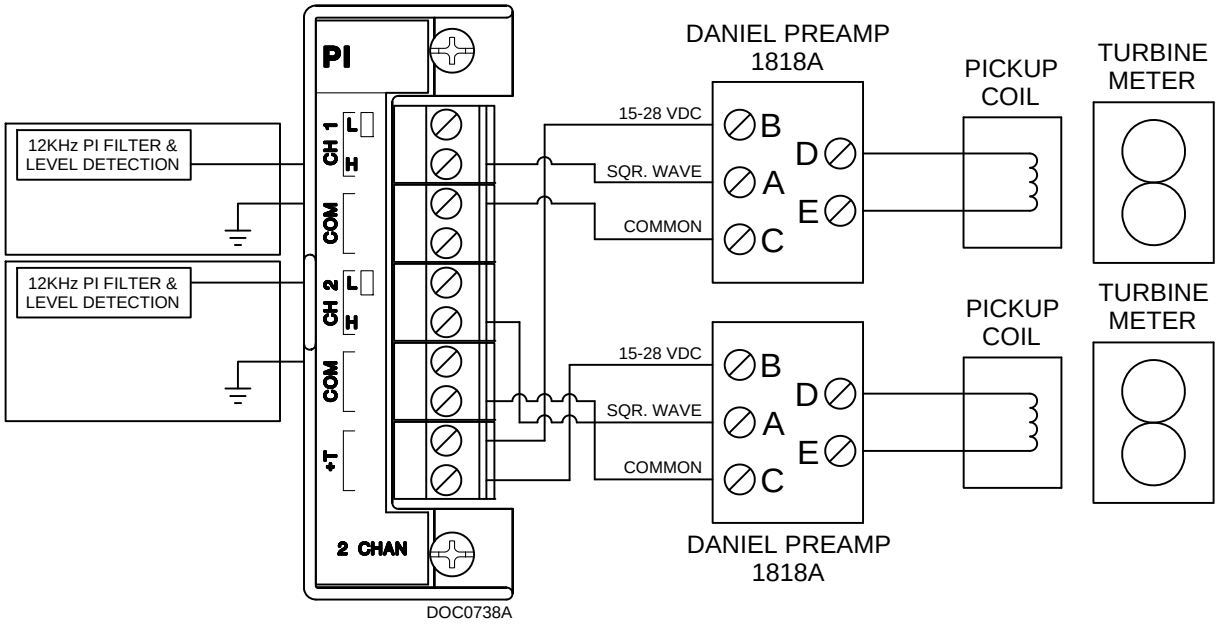
Appendix C – Wiring Diagrams

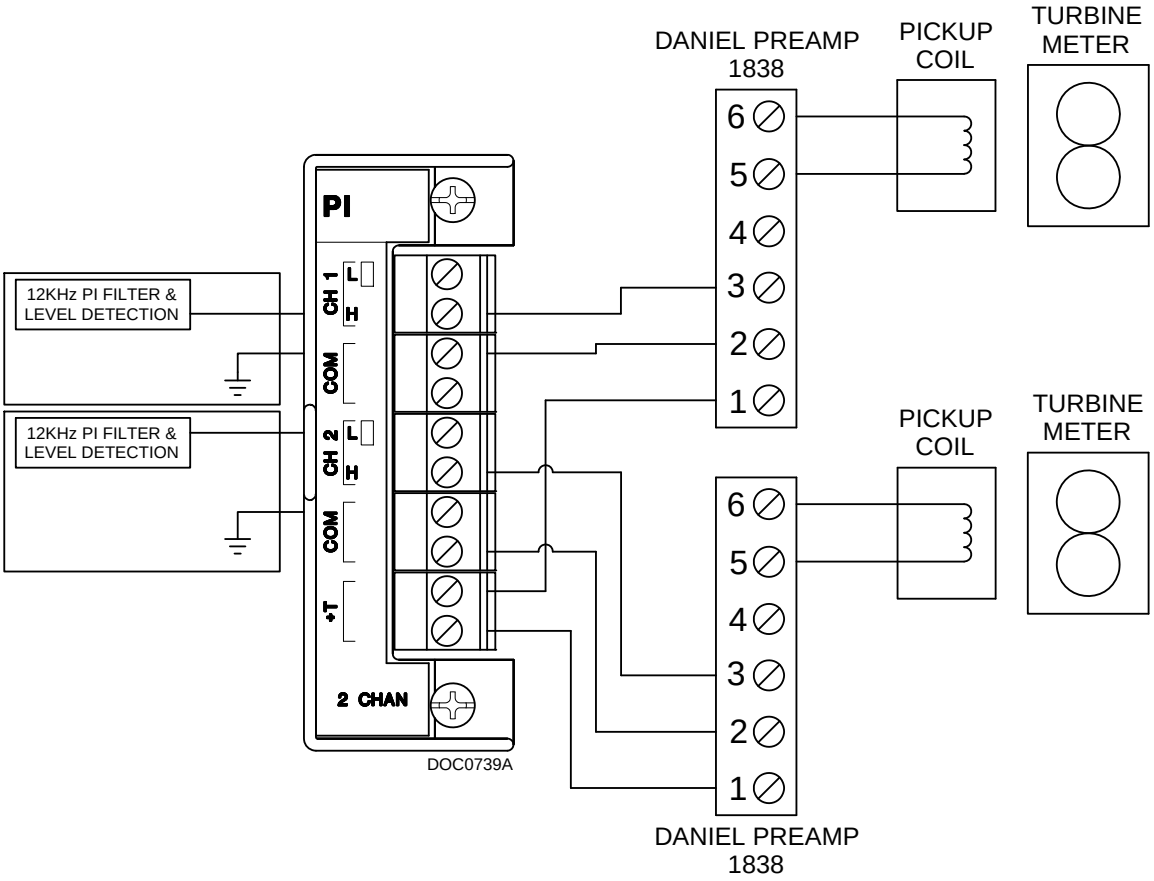
This appendix presents wiring examples for several standard Emerson devices. For other devices, refer to the manufacturer's specifications.

C.1 Daniel Senior Sonic Meter to PI Module

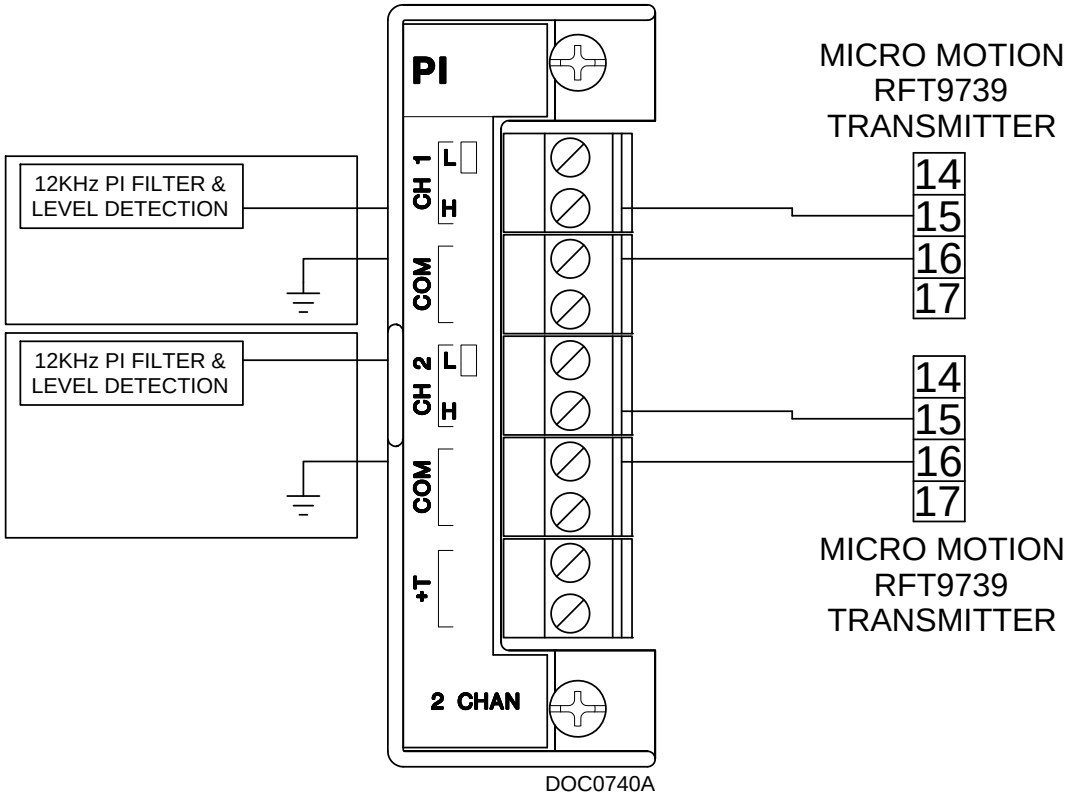


C.2 Daniel 1818A and 1838 Turbine Pre-Amp to PI Module

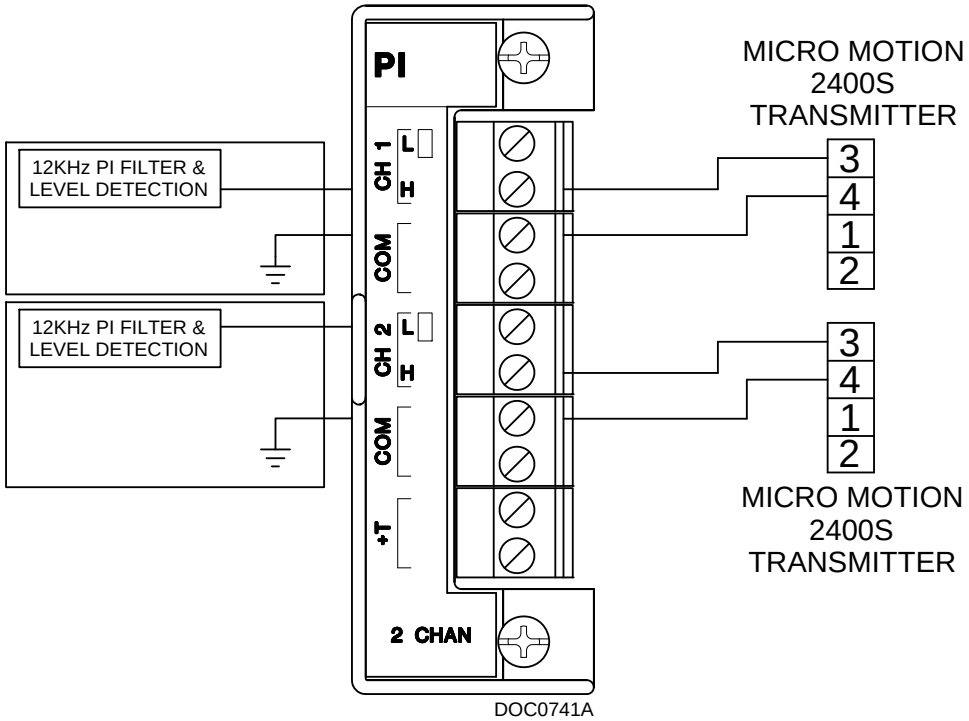




C.3 Micro Motion RFT9739 & 2400S Transmitters to PI Module

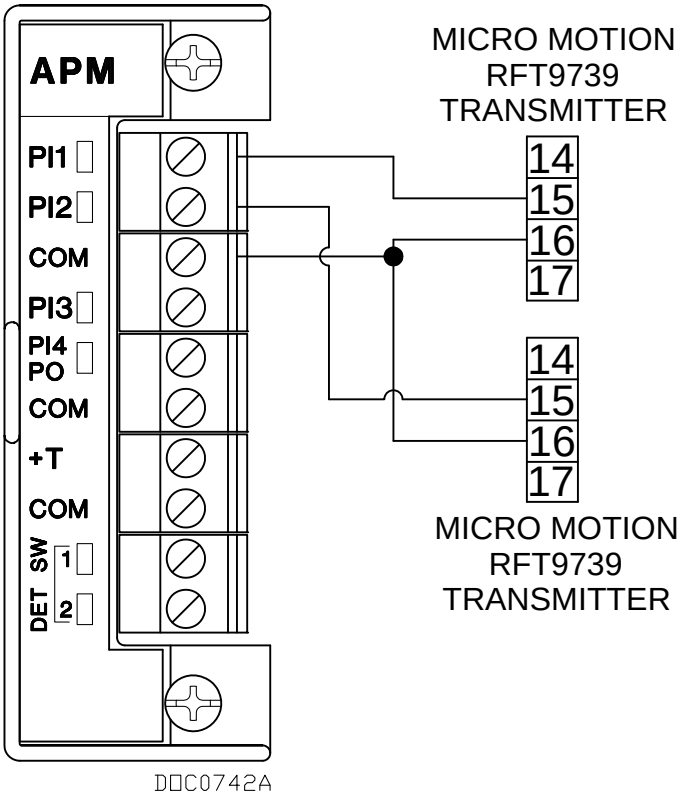


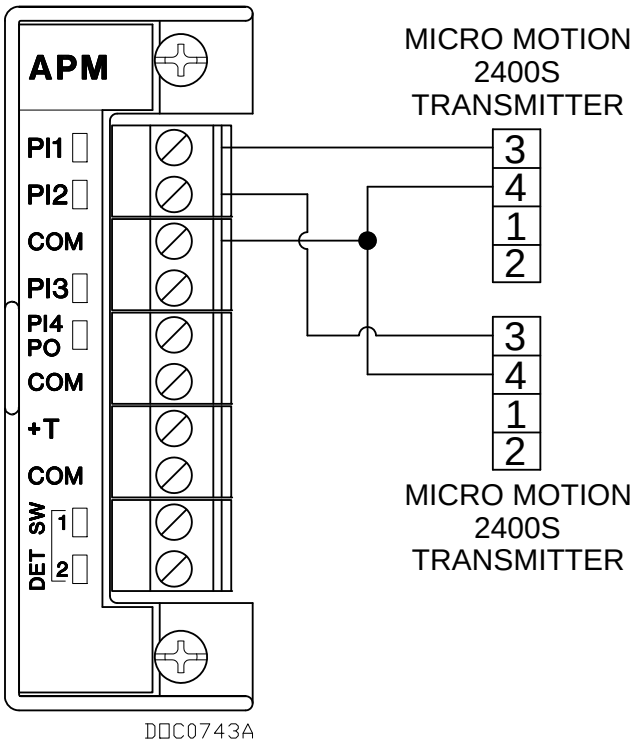
DOC0740A



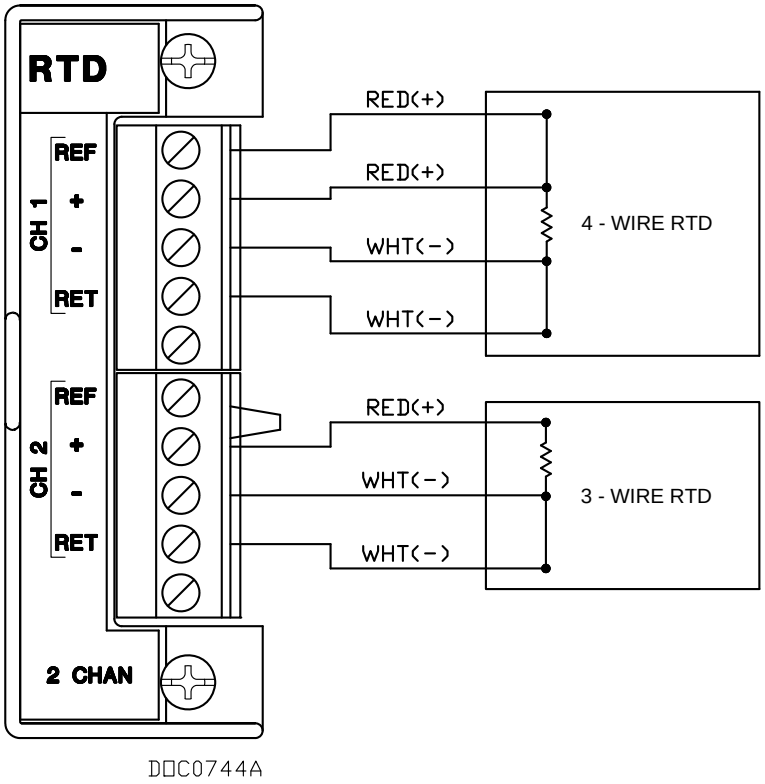
DOC0741A

C.4 Micro Motion RFT9739 & 2400S Transmitters to APM Module

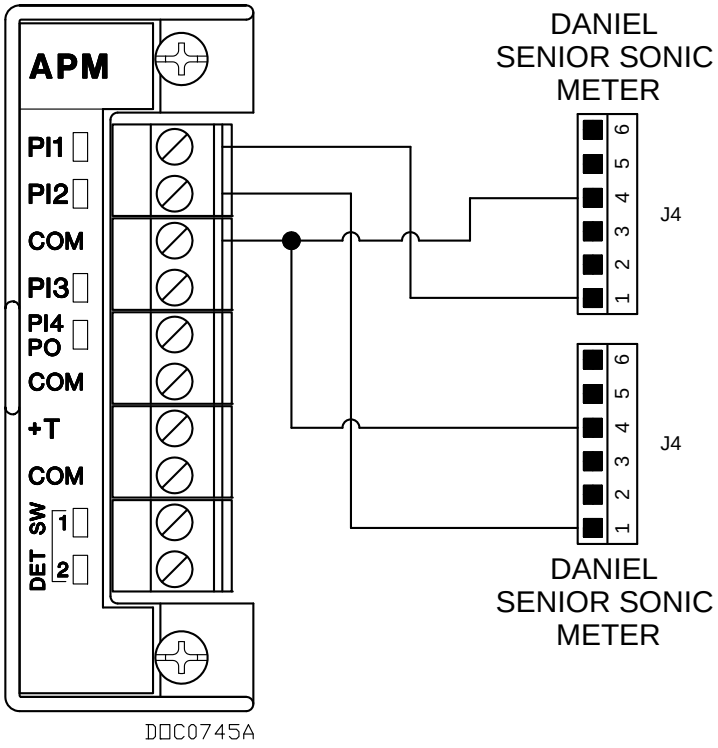




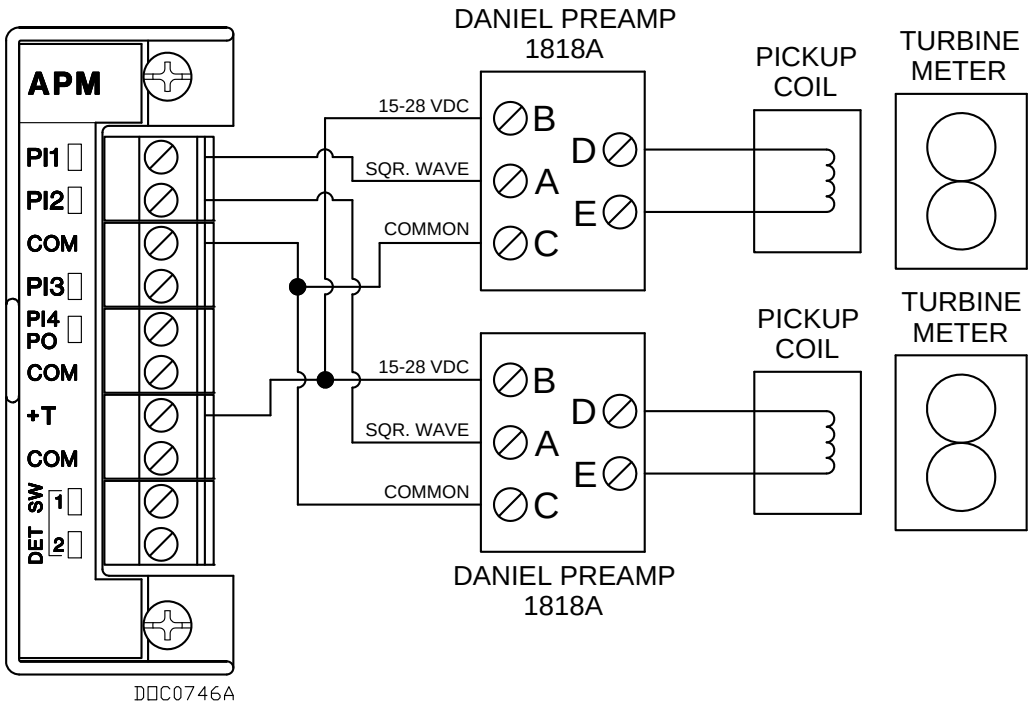
C.5 3- and 4-Wire RTD to RTD Module

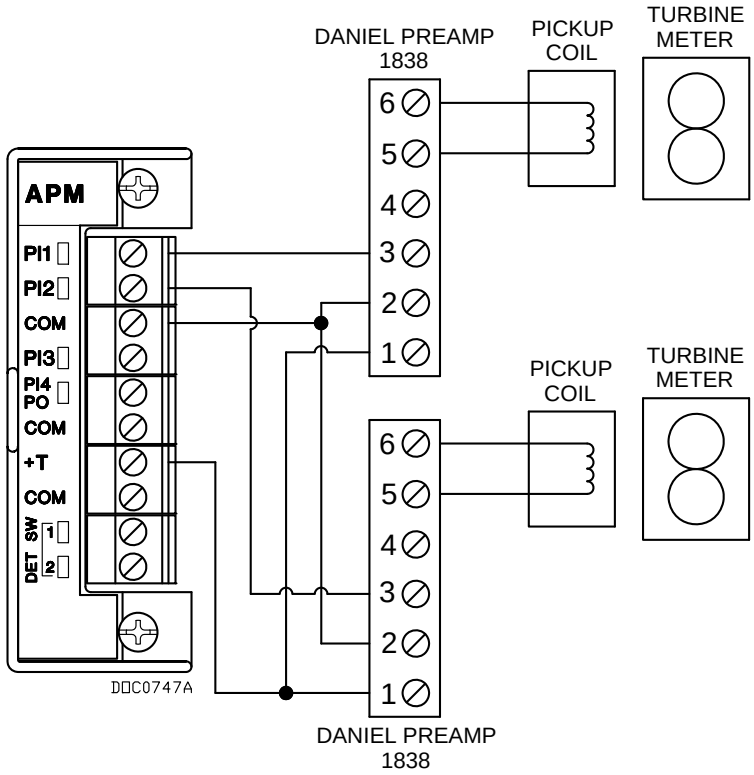


C.6 Daniel Senior Sonic Meter to APM Module

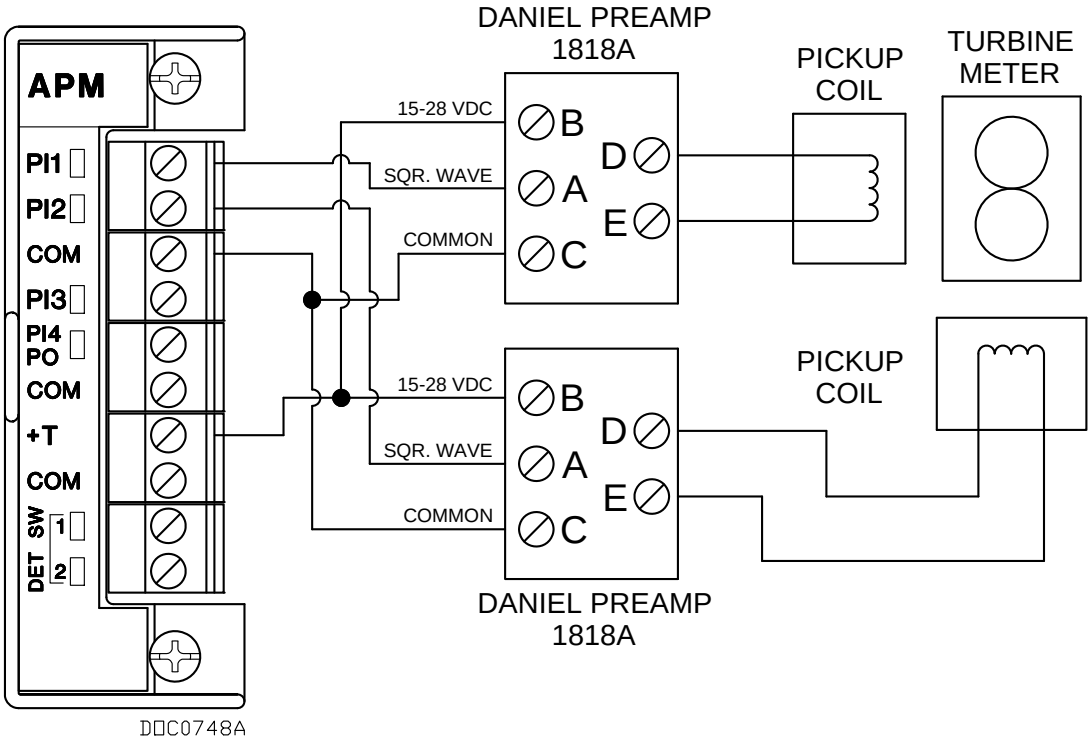


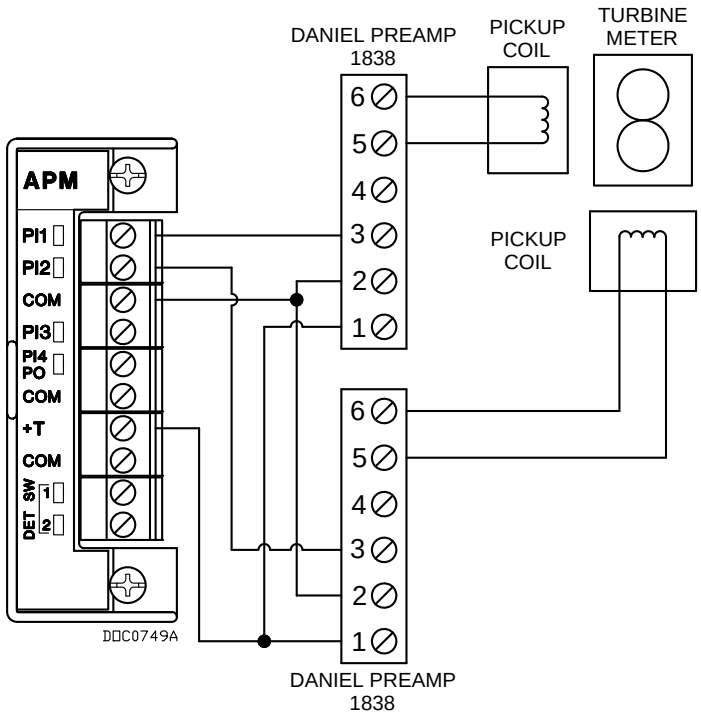
C.7 Daniel 1818A and 1838 Dual Turbine Pre-Amp to APM Module



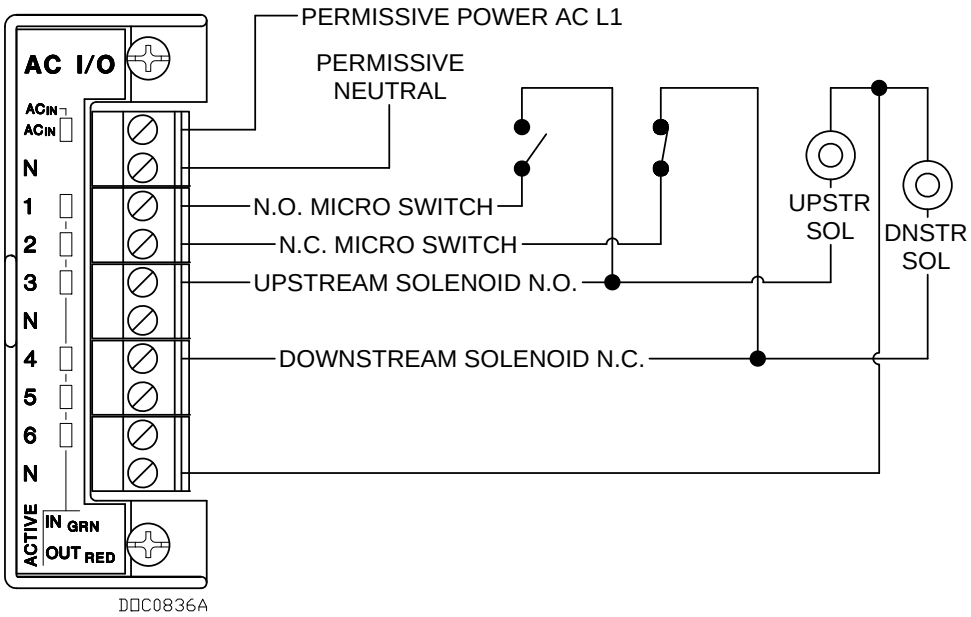


C.8 Daniel 1818A and 1838 Turbine Pre-Amp to APM Module





C.9 Two-Stage Valve with Two Limit Switches to APM Module



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Appendix D – Communications Protocols

This appendix details alternative protocols (other than the native DL8000 protocol) you might use to communicate with the DL8000 preset controller. Currently, Remote Automation Solutions (RAS) supports the Modbus® protocol ("Modbus," developed by Modicon, Inc.) and the DanLoad 6000 protocol ("DanLoad 6000," developed by Daniel, a division of Emerson Process Management).

D.1 Introduction

To communicate with a preset controller, a typical terminal automation system (TAS) may use a communications protocol such as Modbus or DanLoad 6000.

The TAS issues various commands that control preset operations and complete batch delivery with or without operator assistance. Further, the TAS can read configurable parameters, status parameters, and status flags using Modbus registers or DanLoad 6000 read commands.

Note: This appendix provides information to enable backward compatibility to an environment that may include DL8000 presets and DanLoad 6000 presets communicating through **either** the DanLoad 6000 protocol **or** the Modbus protocol. Although the DL8000 preset programs provide a software interface you can use to define options and functions, your TAS may require more specific mappings. Unlike DanLoad 6000 commands or Modbus registers, DL8000 parameters are formatted as TLPs (Point **T**ype, **L**ogical No, **P**arameter No) and are cited in the format [X,Y,Z] where X is the point type number, Y is the logical number, and Z is the parameter number. For that reason we also cite pertinent DL8000 parameters in the format [X,Y,Z] and, when necessary, include specific code values.

The **Modbus** protocol enables a TAS to:

- Read or write configuration parameters
- Read status parameters like totalizers, status flags, alarm status etc.
- Control batch operation

The **DanLoad 6000** protocol enables a TAS to control the entire batch operation but limits access to configuration and status parameters.

Access the Operating Mode field on the Preset Setup screen's General Setup tab (parameter [63,0,36]) to select which of two operating modes the preset uses to interact with a TAS. The operating mode limits the accepted command codes. The operating modes are:

- **Automatic** [value = 0]: The TAS maintains bi-directional communications with the preset and monitors **and** controls batch

delivery operations. All command codes can be used. You can request status information and control preset operation.

- **Manual** [value = 1]: The TAS maintains bi-directional communications with the preset and monitors of batch delivery operations. The TAS **cannot** control batch operation in this mode. Consequently, only certain command codes (which are not for batch control) can be used. You can request status information.

Table D-1 (in *Section D.3, Communications Commands*) lists the commands supported in each protocol and the operating modes in which they are valid.

Definitions/Acronyms/Abbreviations

This appendix uses the following acronyms:

BCC	Block check character
FCV	Flow control valve
K&D	Keyboard and display
ROC	Remote operations controller
TAS	Terminal Automation System
W&M	Weights & Measurement

D.1.1 Communication Channels

A TAS communicates with a preset using any of four comm ports: **COMM2** [63,0,32], **COMM3** [63,0,49], **COMM4** [63,0,139], or **COMM5** [63,0,149]. Each port has the following possible values: **0** (use no protocol), **1** (use Modbus protocol), or **2** (use DanLoad 6000 protocol).

Note: You can use Modbus simultaneously on more than one port. Use ROCLINK 800's Comm Ports screen (**ROC** > **Comm Ports**) and select the **Modbus Slave Only** option to set the port owner [95,x,43] as Modbus slave only [=51].

Unlike the Modbus protocol, the system supports the DanLoad 6000 protocol on only one serial port at a time. It recognizes and uses the first port you configure for the DanLoad 6000 protocol.

D.1.2 Communications Failure

If you have configured a comm port for either Modbus or DanLoad 6000 protocol and the TAS is in **automatic** mode, the system scans for communications failures. It raises an alarm when the DL8000 does not receive a valid request on the specified comm port within the configured time.

Note: You configure this timeout value using the Port 2 Timeout through the Port 5 Timeout fields on the Preset Setup screen's General tab.

This is a primary alarm and is not configurable. You can, however, set the Port Timeout parameter to zero to disable the alarm for that port. Parameters are:

COMM2	[63,0,152]
COMM3	[63,0,153]
COMM4	[63,0,154]
COMM5	[63,0,155]

Note: Use ROCLINK 800's Comm Port screen (**ROC** > **Comm Ports**) to specify the general settings of a serial port to define these settings.

D.1.3 Supported Protocols

The TAS can communicate with a DL8000 using either the Modbus protocol or the DanLoad 6000 protocol.

Modbus Protocol

You can configure a DL8000 to use either Modbus RTU or ASCII transmission modes, and either Most Significant Byte (MSB) or Least Significant Byte (LSB) orders. Set these values using the Comm Mode and Byte Order fields on the General tab of ROCLINK 800's Modbus Configuration screen (**Configure** > **MODBUS** > **Configuration**).

The Comm Mode option [117,x,0] controls the type of transmission mode: **RTU** (Value=0) or **ASCII** (Value=1). The Byte Order option [117,x,1] controls which byte is sent out first for floats, short integers, and long integers. Valid values are **Least Significant Byte First** (Value=0), associated with little-endian processors or Most Significant Byte First (Value=1), associated with big-endian processors.

The Modbus protocol is a register-based protocol. You have to map Modbus registers to the DL8000 TLP parameters. Refer to *Section D.4, Mapping Modbus Registers*.

DanLoad 6000 Protocol

The DanLoad 6000 protocol is Modbus-compatible protocol, since it uses Modbus RTU message framing. Modbus function codes for normal queries and responses are 0x41 and 0x42 (hexadecimal). The Modbus protocol reserves function codes 0x41 to 0x48 for user-defined "custom functions." Consequently, the DanLoad 6000 protocol is a *customized* Modbus protocol.

Under DanLoad 6000 protocol, the TAS system establishes communication using a Start Communications command (hex value 0x21). This initializes the DanLoad 6000 alternating sequence function code to the function code in the Start Communication command. The operation at DanLoad 6000 remains unaffected by Start Communications command (hex 0x21).

The maximum query message length for Modbus RTU is 256 bytes (including check characters). The same length is true for response messages.

In DanLoad 6000 protocol, a normal query and response frame consists of the following fields:

- Address (one character)
- Function code (one character) – alternating hexadecimal 0x41 and 0x42.
- Data field length = N (one character) – including this character and data field but excluding checksum bytes
- Data field (=N-1 characters where first character is a command code and subsequent characters area data for the command)
- BCC checksum (two characters)

The exception response frame has the following format:

- Address (one character)
- Function code (one character) – 0xC1 and 0xC2 to indicate "exception responses" to function codes 0x41 and 0x42 respectively
- Data field length = N (one character)
- Data field (=N-1 characters where first character is a command code and subsequent characters are data for the command)
- BCC checksum (two characters)

For further information, see *Section D.5, DanLoad 6000 Protocol Frame*.

The destination station uses block check characters (BCCs) to verify the accuracy of the data received. The receiving station calculates the BCC for the command query message it receives and then compares the calculated BCC with the received BCC. Any differences indicate a data error; the destination does not reply to such command frames.

The DL8000 knows which function code to expect from the TAS. If it receives hex 41h when it expects hex 42h or vice versa (and the command is not a Start Communications command), the preset assumes a retry by the TAS and retransmits exactly the last response sent to the TAS on the communication channel.

Additionally, the DL8000:

- Uses function codes C1h and C2h to indicate "exception responses" to function codes 41h and 42h, respectively.
- Does not respond to a "broadcast" messages (that is, where the address field equals zero).
- Operates as an addressable slave station, and "speaks only when spoken to."

The DL8000 does not respond to a message that is "incorrectly framed" (that is, not its address, an unused function code, or an incorrect error check). It also does not respond to a message that is "incomplete" (containing either fewer or more characters than expected).

Gross Volume is a default value for commands which return total values. The DL8000 can return one other value, depending on what you enter in the Preset Delivery Type field [63,0,29] on the Preset Setup screen's General Setup tab. Enter **Mass** (for mass total values) or **Standard** (for net standard total values).

Using the DanLoad 6000 protocol, when the TAS communicates with the preset, the preset **does not** check for the following:

- If write command (for hex 0x0B, 0x0C, 0x27) is issued, the preset does not check whether the TLP is a W&M type.

Note: Refer to the *DanLoad 6000 Communications Specifications Manual* (Part Number 3-9000-674, Revision 2.1, publication date September 1998) for details on the DanLoad 6000 protocol and command request or query frame.

D.1.4 Configuration

To set up a serial port in the DL8000, use the following configurations:

Value	Description	
Device Address	Sets the DL8000's address [91,0,0]. Select **Device Address** from the Address to Use frame on the Device Information screen's Internet tab (**ROC** > **Information**).	
Serial Port Setting	Configures the serial port. Set the following values on the Comm Port screen (**ROC** > **Comm Ports**).	
	Baud Rate	Valid baud rates for the Modbus and DL6000 protocols are 300, 600, 1200, 2400, 4800. 9600, 19200, 38400, and 57600. [95,x,1] and [91,0,31 to 91,0,34]
	Parity	Sets parity error checking, in which the host adds a 1 or 0 bit to the character to make it even or odd. The receiver then decodes this value and an error occurs if the bit number is not correct. Valid values are **0** (no parity), **1** (odd parity), or **2** (even parity). [95,x,4]
	Data Bits	Sets the number of data bits in a character. Valid values are **7** or **8**. [95,x,3]
	Stop Bits	Sets the number of stop bits in a character. Valid values are **1** or **2**. [95,x,2]

Value	Description	
Serial Port Setting (continued)	**Port Owner**	Sets the program that currently "owns" or controls the port. [95,x,43] Valid values are: ▪ ROC Plus Protocol/Modbus Slave (0) ▪ Modbus Master (COMM1 through COMM5) (1) ▪ DS800 (not valid for COMM1) (2) ▪ LCD (3) ▪ I/O Module (Read-only) (4) ▪ User C++ Program 1 (5) ▪ User C++ Program 2 (6) ▪ User C++ Program 3 (7) ▪ User C++ Program 4 (8) ▪ User C++ Program 5 (9) ▪ User C++ Program 6 (10) ▪ User C++ Program 7 (11) ▪ User C++ Program 8 (12) ▪ ROC Plus Protocol only (50) ▪ Modbus Slave Only (51)

D.1.5 Commands

Under the DanLoad 6000 protocol, the command request frame contains all the data required to execute a command. The TAS should send a command request frame on the port configured for the DanLoad 6000 protocol. The DL8000 supports most of the DanLoad 6000 protocol commands.

Under Modbus, however, you must use Modbus write function codes for the respective command parameters before issuing a command to the DL8000. The TAS then writes a command to the TA command parameter [63,0,166].

The DL8000 processes this command or command request frame and then writes any exception codes [63,0,168]. The value of 255 indicates no exception. The DL8000 then checks for the following general exceptions:

- If the TAS-issued command should be a valid TAS command based on operating mode.
- If the TAS issues any command (other than Clear Status) when the DL8000 is in program mode.

Note: Command-specific exceptions are included in the descriptions of each command (see *Sections D.3.1* and *D.3.2*).

If the system finds no exceptions during the processing of commands, it sets and resets any required status flags [63,0,119] and controls the DL8000 based on the command. Refer to *Section D.9* and *D.10* for a list of exception codes the Modbus or DanLoad 6000 protocols might raise.

Although the exception code numbers raised are same for both Modbus and DanLoad 6000 protocols, the DanLoad 6000 protocol has additional exceptions.

D.1.6 Status Flags

The Status Flags parameter [63,0,119] maintains various process values which the TAS uses to monitor the status of both the DL8000 and the overall batching operation.

Note: These values accumulate in the TLP and do not currently appear on any system report or screen.

Bit (Decimal)	Bit (Hex)	Description
00	00	Operating Mode is Manual
01	01	Primary Alarm
02*	02*	Passcode Entry in Progress
03*	03*	Operation Timed Out
04*	04*	Recipe Selected
05*	05*	Additive Selected
06*	06*	Preset Volume Entered
07*	07*	Keypad Data Available
08	08	Program Code Value Changed
09*	09*	Transaction in Progress
10*	0A*	Batch in Progress
11*	0B*	Key Pressed
12	0C	Transaction Ended
13	0D	Batch Ended
14*	0E*	Batch Aborted (not started)
15*	0F*	Intermediate Level Input Alarm Stopped batch (not currently supported)
16	10	Batch in Configuration Mode
17	11	Batch Authorized
18	12	Transaction Authorized
19	13	Transaction End Requested
20	14	K&D Locked Out to Automation System
21	15	Batch Stopped (Resumable)
22	16	Program Mode
23*	17*	Flowing

An asterisk (*) indicates status flags that are reset when you power up the DL8000. Refer to *Section D.8, Status Flag Descriptions* for a list of status flags that the system sets or resets based on various conditions.

When the DL8000 is in Auto mode, you can clear some status flags from the TAS using the Clear Status command (hex 0x13). You can update the following flags:

- Operation Timed Out (0x03 bit)
- Recipe Selected (0x04 bit)
- Additive Selected (0x05 bit)
- Preset Volume Entered (0x06 bit)
- Keypad Data Available (0x07 bit).
- Program Code Value Changed (0x08 bit).
- Key Pressed (0x0B bit)
- Transaction Ended (0x0C bit)
- Batch Ended (0x0D bit)
- Batch Aborted (0x0E bit)
- Transaction End Requested (0x13 bit)
- Program Mode (0x16 bit)

The K&D Locked Out flag indicates that the TAS cannot display message on screen. You can use the timeout operation command [0x05] to clear K&D Locked Out flag, but only when the batch is not in progress. When the DL8000 displays a "Please Wait" message to the operator, that message indicates that the operator should wait until next command or message is received from the TAS.

D.2 Batch Control in Auto Mode

This section discusses the sequence of actions required to remotely control the entire batching operations from a TAS.

D.2.1 Steps for Authorizing a Transaction

The DL8000 allows you to load a preset volume of a product, blend, or recipe as a "batch." The operator or the TAS sets the (preset) volume. The batch begins when the operator presses the Start key on the preset. The batch ends when delivery of product has stopped and cannot be resumed without beginning a new batch. When a preset volume of a multi-component sequential or in-line blend is loaded, this is just one batch.

On the DL8000, one or more batches can load on a single "transaction." The system assigns each transaction a unique four-digit sequence number when the transaction starts. Similarly, the system assigns each batch within the transaction a unique four-digit sequence number when that batch starts. All batches on a transaction have the **same recipe** and the **same additives** and share the **same** operator-entered "**data items**." The system stores the transaction sequence number of the currently loaded or the last loaded transaction at [63,0,124], and stores the batch sequence number of the currently loaded or the last loaded batch at [63,0,125].

The following sections detail the steps to authorize a new recipe (that is, a transaction).

Selecting a Recipe

Before a transaction can begin an operator must select a recipe. The TAS can use the Prompt Recipe (hex 0x01) command and request the DL8000 to prompt the operator for a recipe selection. The DL8000 then displays a recipe selection screen on which the recipe names display beginning with the first recipe up to the maximum number of configured recipes [63,0,26]. The operator must select a recipe within configured timeout time [63,0,171]; otherwise, the DL8000 aborts the operation and sets a timeout flag (bit 3 in [63,0,119]).

Note: If you set the timeout to zero then a timeout does not occur.

When the operator selects a recipe, the DL8000 sets a Recipe Selected flag (bit 4 in [63,0,119]) telling the TAS that it can read the recipe selected. The Recipe Selected flag is subsequently cleared either by another Prompt Recipe command or a Clear Status [0x13] command.

In the DanLoad 6000 protocol, the TAS reads the selected recipe [63,0,118] using a Request Selected Recipe command (hex 0x02). In the Modbus protocol, the TAS can directly read the value of the selected recipe [63,0,118] using a read function code.

At this point, the TAS can either use the operator-selected recipe or its own recipe to authorize a transaction. A new recipe [63,0,118] can be changed by directly writing to recipe selection [63,0,10] without the TAS issuing a Prompt Recipe command when a transaction is not authorized, no primary alarms are active, and the Operation Timed Out flag is not set. This means that if the TAS can determine the recipe number **without** input from the operator, the Prompt Recipe and Request Selected Recipe commands are **not** required.

Selecting One or More Additives

Up to six additives can be selected before the system authorizes a transaction. The TAS can command the DL8000 to prompt the operator for an additive selection using the Prompt Additive command (hex 0x03). A “suggested” additive [63,0,170] can display for the operator; the selection of “no additives” is a valid additive selection.

When the system issues the Prompt Additive command, it locks the keypad and display to the TAS. The DL8000 displays the additive selection screen with the suggested additive. The operator must select an additive within the timeout time [63,0,171]; otherwise, the system aborts the operation and sets a timeout flag (bit 3 in [63,0,119]).

Note: If you set the timeout to zero then a timeout does not occur.

When the operator selects an additive, DL8000 sets the additive selected flag (bit 5 in [63,0,119]), indicating that the TAS can read the selected additive. The additive selected flag is subsequently cleared either by another Prompt Additive command or a Clear Status (hex 0x13) command.

In the DanLoad 6000 protocol, the TAS reads the selected additive bitmap [63,0,112] using Request Selected Additive command (hex 0x04). In the Modbus protocol, the TAS can directly read the selected additive [63,0,112] using a read function code.

At this point the TAS can either use the operator-selected additive or its own additive to authorize a transaction. A new additive bitmap [63,0,112] can be changed by directly writing to the additive bitmap [63,0,60] without the TAS issuing a command when the transaction is not authorized, no primary alarms are active, and the Operation Timed Out flag is not set. This means that if the TAS can determine the additive selection **without** input from the operator, the Prompt Additive and Request Selected Additive commands are **not** required.

Prompting for Auxiliary Data Items

The TAS can command the DL8000 to prompt the operator for data (such as customer number, order number, or compartment number) using the Display message (hex 0x1C) command.

Using the Number of Data Items field on the Preset Setup's General tab, you can define up to five auxiliary data items for the operator to complete. You then use the Number of Data Items field to indicate the number of prompts to display. If the auxiliary data index [63,0,178] is not zero and the TAS issues this command, the DL8000 then prompts the operator with appropriate messages Data Prompt 1 [63,0,187], Data Prompt 2 [63,0,189], Data Prompt 3 [63,0,191], Data Prompt 4 [63,0,193], and Data Prompt 5 [63,0,195]. The number and sequence of displayed data prompts depends on the value in the auxiliary data index TLP.

When the operator enters data from the keypad, DL8000 sets a flag (bit 7 in [63,0,119]) to indicate when keypad data is available. Based on the auxiliary data item number, the system writes data entered from the keypad as Data Item 1 [63,0,188], Data Item 2 [63,0,190], Data Item 3 [63,0,192], Data Item 4 [63,0,194] and Data Item 5 [63,0,196].

If a transaction is not authorized and the Operation Timed Out flag is not set (bits 18 and 3 in [63,0,119]), then the system can directly write auxiliary data items 1 to 5 without the TAS issuing this command.

In the DanLoad 6000 protocol, the TAS obtains the keypad data using the Request Keypad Data [0x1D] command. In the Modbus protocol, the system can directly read entered data items from appropriate Data item 1 through Data item 5.

Authorizing the Transaction

The TAS "authorizes" a transaction using the Authorize Transaction command (hex 0x06). This command:

- Sets the recipe, additives, and data items.

  Note: Write the recipe, additive, and data items before you issue the Authorize Transaction command.

- Sets the Transaction Authorized flag (bit 18 in [63,0,119]).
- Clears the Additive Selected and Recipe Selected flags (bits 5 and 4 in [63,0,119]).
- Displays (if it is not already) the loading screen.
- Increments the transaction sequence number [63,0,124], which rolls from 9999 to 0 to indicate the prospective sequence number of the transaction (if it starts).

Note: The transaction does not actually start ("in progress") until the first batch starts. The DL8000 sets a Transaction in Progress flag (bit 9 in [63,0,119]) to indicate that a transaction is actually in progress.

D.2.2 Steps for Authorizing a Batch

The following sections explain the steps for authorizing a new batch for loading the required preset.

Preset Volume for Batch

The TAS can command the DL8000 to prompt the operator for a preset volume using the Prompt Preset Volume command (hex 0x08). When the TAS issues this command, the DL8000 displays a preset selection screen. This command can optionally send a "suggested preset volume" [63,0,185].

The operator can either press **Enter** to accept the displayed preset or press **Alt** + **Backspace** to change the preset volume. The operator must enter the preset volume within the timeout time [63,0,171]; otherwise the DL8000 aborts the operation and sets an Operation Timed Out flag (bit 3 in [63,0,119]).

Note: If you set the timeout to zero then a timeout does not occur.

Once the operator enters a preset value, the system sets the preset entered flag (bit 6 in [63,0,119]). The Preset Volume Entered flag is subsequently cleared by another Prompt Preset Volume command or a Clear Status (hex 0x13) command.

In the DanLoad 6000 protocol, the TAS can read the entered preset volume [63,0,39] using a Request Preset Volume command (hex 0x09).

In the Modbus protocol, the TAS can directly read the value at this parameter using read function code.

If the batch is not authorized and the operation timeout flag is not set (bits 17 and 3 in [63,0,119]) then new preset qty [63,0,39] can be changed by directly writing to preset quantity [63,0,0] without the TAS issuing this command. This means if the TAS can determine the batch volume **without** input from the operator, the Prompt Preset Volume and Request Preset Volume commands are **not** required.

Batch Authorization

The TAS issues an Authorize Batch command (hex 0x0A) to authorize a new batch for given preset volume [63,0,39].

In the DanLoad 6000 protocol, the command request frame includes the desired preset volume. For the Modbus protocol the preset value should be directly written at preset quantity [63,0,0].

When the TAS issues the Authorize Batch command:

- The DL8000 displays a loading screen which displays “Start to Load” and “Stop to Abort” messages.
- The system sets the batch authorized flag (bit 17 in [63,0,119])].
- The system increments the batch sequence number [63,0,125] by 1 (which rolls from 9999 to 0) indicating the prospective sequence number of the batch if started.

The operator initiates loading by pressing **Start** within the timeout time [63,0,171]. If the batch is aborted (that is, if the operator presses **Stop** instead of **Start or** the DL8000 times out waiting for the **Start** key to be pressed), the DL8000 sets the batch aborted and timeout flags (bits 14 and 3), resets the batch authorized flag (bit 17 in [63,0,119]), and reduces the batch sequence number [63,0,125] by 1.

Batch Start/Restart

The operator can press **Start** or the TAS can issue a Start/Restart Batch command (hex 0x0E) to start a new batch or restart a batch which is in progress but stopped (bits 10 and 21 in [63,0,119]), provided no active alarm has a severity more than Info (for example, the Current Alarm Type [63,0,64] has value 0 or 1).

When a batch has been started, the DL8000 sets a flag (bit 10 in [63,0,119]) to indicate that a batch is in progress.

D.2.3 Stop/End of Batch

Batch delivery stops when **any** of the following conditions occurs -

- The operator presses **Stop**.

- The TAS issues a Stop Batch command [0x0F] when the batch is in progress and not stopped (bits 10 and 21 in [63,0,119]).
- An alarm with a severity greater than info is raised (for example, the Current Alarm Type [63,0,64] has a value more than 1).

A batch that is stopped because of these conditions **may** be restarted. The DL8000 sets a flag (bit 21 in [63,0,119]) to indicate that the batch has stopped and can be restarted.

A batch **ends** when either of the following conditions occurs -

- The preset volume of all the components in the blend or recipe has been delivered.
- The TAS issues an End Batch command (hex 0x0D) when batch is in progress and stopped (bits 10 and 21 in [63,0,119]).
- Batch has been stopped when the batch remaining quantity [63,0,3] is less than minimum preset quantity [63,0,27].

A batch that has ended **cannot** be restarted. The DL8000 sets a Batch Ended flag (bit 13 in [63,0,119]) to indicate that the batch has ended and is not restartable. The authorization of a new batch or the issue of a Clear Status command clears the batch ended flag.

In the DanLoad 6000 protocol, the TAS uses the Batch Data by Component command (hex 0x10) to obtain batch data (batch volumes, component temperatures, batch sequence number, transaction sequence number, and so on) for a batch that has ended.

D.2.4 End of Transaction

In **automatic** operating mode, any of the following conditions can end a transaction:

- The TAS issues an End Transaction command (hex 0x07) when the transaction is authorized and there is no batch in progress (bits 18 and 10 in [63,0,119]).
- The operating mode [63,0,36] is changed and transaction was authorized.
- The DL8000 was powered and a transaction in progress when the DL8000 was powered down.

In **manual** operating mode, you can end a transaction by pressing **Stop** on the DL8000, provided no batch is in progress.

In **automatic** mode, an operator can press **Stop** to request the TAS to end the transaction. The DL8000 then sets the Transaction End Requested flag (bit 19 in [63,0,119]). The TAS reviews this flag and issues an End Transaction command (hex 0x07). When the DL8000 receives an End Transaction command, it sets a flag (bit 12 in [63,0,119]) to indicate that the transaction has ended. The authorization of a new transaction or the issue of a Clear Status command clears the Transaction Ended flag.

In the DanLoad 6000 protocol, the TAS uses the Transaction Data by Component command (hex 0x1F) to obtain transaction data (transaction volumes, meter totals, data items, etc.) from the DL8000.

D.2.5 Batching Status States

The Batching Status parameter [63,0,9] maintains various process values which the TAS uses to monitor the status of both the DL8000 and the overall batching operation.

Note: These values accumulate in the TLP and do not currently appear on any system report or screen.

State	Description	Notes
0	Idle	
1	Select_Recipe	
2	Invalid_Recipe	
3	Enter_Preset	
4	Invalid_Preset	
5	Batch_Auth	
10	Alarm_Batch_Halt	
12	User_Batch_Halt	
13	Batch_Complete	
20	Start_Pump	Ratio blending only
21	Line_Pack	
22	Wait_for_Line_Pack	
23	Flow_Control	
24	Valve_Close	
25	Pump_Stop_Delay	
26	Wait_for_Pump_Stop	
27	Stop_Pump	
28	Wait_All_Stop	
29	Batch_Halt	
30	Next_Component	Sequential blending only
31	Line_Flush	
32	End_of_Batch	
33	Wait_Full_Valve_Close	
34	Close_Block_Valve	
37	End_Batch	
38	End_Transaction	
50	Select_Additive	
60	Archive_Transaction	

D.3 Communications Commands

This section details all commands the Modbus and DanLoad 6000 protocols support.

D.3.1 Modbus Commands

You use Modbus commands when using the register-mapped Modbus protocol. *Table D-1* lists the executable commands available in the Modbus protocol. These commands are called "executables" since they force the DL8000 to perform certain kind of activities. The table also specifies the operation mode in which each command is valid.

Table D-1. Modbus Executable Commands

Cmd No (decimal)	Cmd No (hex)	Command Name	Operating modes [Auto/Manual]
1	1	Prompt Recipe	Auto
3	3	Prompt Additives	Auto
5	5	Timeout Operation	Auto
6	6	Authorize Transaction	Auto
7	7	End Transaction	Auto
8	8	Prompt Preset Volume	Auto
10	A	Authorize Batch	Auto
13	D	End Batch	Auto
14	E	Start/Restart Batch	Auto
15	F	Stop Batch	Auto
19	13	Clear Status	Auto
20	14	Reset Primary Alarms	Auto
28	1C	Display Message	Auto
41	29	Set Date and Time	Auto/Manual
48	30	Reset Unit	Auto/Manual
55	37	Change Operating Mode	Auto/Manual
56	38	Clear Display	Auto
61	3D	Report Alarm	Auto/Manual

The following sections describe all the commands supported in the Modbus protocol, including the supporting parameters required for the execution of each command, status flags changed during each command, and exceptions checked.

When using Modbus, you use function codes to write the data for respective parameters required for the execution of commands in advance before issuing the command to the DL8000. Refer to the

"Supporting Parameters" section of each command description. Other parameters used in the execution of the command are described as well.

The TAS writes commands using the Modbus write to TA command [63,0,166]. The DL8000 first checks for all types of exceptions for a given command. If any exception is raised, the DL8000 then writes an exception code [63,0,168]. An exception causes the DL8000 to terminate further execution; otherwise, it executes the complete command. A value of **255** indicates no exception.

If the DL8000 finds no exceptions during the processing of a command, it sets and resets any required status flags [63,0,119] and controls the DL8000 based on the command.

Apart from this, the TAS can use Modbus read and write function codes for the following activities:

- Configuration of DL8000
- Reading status flags and totalizers
- Reading alarm status

Prompt Recipe [0x01]

Allows the TAS to let an operator select a recipe at the DL8000. The command locks out the keypad and display (K&D) to the TAS.

The DL8000 displays a recipe selection screen to operator on which the recipe names displayed starting from first recipe up to the number of recipes [63,0,26] configured. The operator has to select a recipe within the timeout time [63,0,171]; otherwise the operation aborts and sets the Operation Timed Out flag (bit 3 in [63,0,119]). If a timeout occurs, it blocks any further recipe selection.

If you set the timeout to zero, then the timeout doesn't occur. You must then use the Timeout Operation command (0x5) to end this operation.

The TAS can change the recipe selection by writing its own value at [63,0,10] (using the Modbus write function code), but only when the transaction is **not** authorized and the Operation Timed Out flag is **not** set.

Flags Immediately Set	K&D Locked Out
Flags Immediately Cleared	▪ Operation Timed Out ▪ Recipe Selected
Exceptions	▪ Transaction Authorized ▪ K&D Locked Out ▪ Primary Alarm active ▪ Operating Mode is Manual ▪ Passcode Entry in Progress
Supporting Parameters	Timeout time [63,0,171]
Results	When an operator selects recipe, the DL8000 sets the Recipe Selected flag (bit 4 in [63,0,119]) to tell the TAS that it can read the recipe selected. The TAS can read selected recipe [63,0,118] using Modbus read function code.

Prompt Additives [0x03]

Allows the TAS to let an operator select additives at the keypad. The command locks out the keypad and display to the TAS.

The DL8000 displays an additive selection screen with the suggested additive selection [63,0,170]. The suggested additive selection can also be “no additives.” The operator has to select an additive within the timeout time [63,0,171]; otherwise the operation aborts and sets the Operation Timed Out flag (bit 3 in [63,0,119]). If a timeout occurs, it blocks any further additive selection.

If you set the timeout to zero, then the timeout doesn’t occur. You must then use the Timeout Operation command (0x5) to end this operation.

This command does not result in an additive selection being set in the DL8000. It just allows the TAS to obtain a possible additive selection from an operator at the DL8000. The TAS can change the additive selection by writing its own value at [63,0,60] (using Modbus write function code), but only when the transaction is **not** authorized and the Operation Timed Out flag is **not** set.

Flags Immediately Set	K&D Locked Out
Flags Immediately Cleared	▪ Operation Timed Out ▪ Additive Selected
Exceptions	▪ Passcode Entry in progress ▪ Primary Alarm active ▪ Transaction Authorized ▪ Operating Mode is Manual ▪ K&D Locked Out ▪ Additive selection method [63,0,102] is not prompt ▪ Number of additives [63,0,100] is zero ▪ Dependent user program is not in running state in Preset
Supporting Parameters	▪ Timeout time [63,0,171] ▪ Suggested additive [63,0,170]
Results	When an operator selects an additive, the DL8000 sets the Additive Selected flag (bit 5 in [63,0,119]) to tell the TAS that it can read the selected additive. The TAS can read additive selected bitmap [63,0,112] using Modbus read function code.

Timeout Operation [0x05]

If this command is issued when the DL8000 is prompting for a recipe, for additives, for a preset volume, for keypad input, displaying a message, or waiting for the operator to start or abort a batch, then the current operation times out. The DL8000 displays the existing screen with a "Timeout Operation" and “Please wait” message. If Operation Timed Out [63,0,171] is equal to zero then TAS can terminate a user prompt command or display message command by issuing a Timeout Operation command.

Flags Immediately Set	Operation Timed Out
Flags Immediately Cleared	K&D Locked Out
Exceptions	▪ Batch in Progress ▪ Operating Mode is Manual ▪ Passcode Entry in Progress
Supporting Parameters	None
Results	If the DL8000 is displaying any prompt or message then current operation times out. The DL8000 displays the existing screen with a "Timeout Operation" and “Please wait” message.

Authorize Transaction [0x06]

Authorizes a transaction with selected recipe [63,0,118], additive [63,0,112], and data items [63,0,188;190;192;194;196]. The TAS can override an operator selection and provide a new recipe, additive, or data items before authorizing the transaction. The DL8000 displays the loading screen.

Flags Immediately Set	Transaction Authorized
Flags Immediately Cleared	▪ Recipe Selected ▪ Additive Selected ▪ Transaction Ended ▪ Transaction End Requested ▪ Transaction in Progress

Authorize Transaction [0x06]

Exceptions	▪ Passcode Entry in Progress ▪ Primary Alarm active ▪ Transaction Authorized ▪ Operating Mode is Manual ▪ K&D Locked Out ▪ Invalid recipe number (Recipe selected [63,0,10] is more than number of recipes [63,0,26]) ▪ No recipe selected (recipe selected [63,0,1] is 0) ▪ Invalid additive selection method [63,0,102] ▪ Invalid additive selection ▪ Invalid swing arm side (applicable only for Version 2.0 and later) ▪ Recipe verification fail (error code [63,0,95] is set) ▪ Additive user program is not running in DL8000 ▪ Additives module is running in DL8000 and suggested additive method [63,0,170] is not either 0 or 1. Returns Invalid additive selection method exception. ▪ Suggested additive method [63,0,170] is 0 and additive bitmap [63,0,112] is set to more than configured number of additives [63,0,100]. ▪ Suggested additive method [63,0,170] is 1 and additive bitmap picked up (as per the additive selection method) has additive bits set more than configured number of additives [63,0,100].
Supporting Parameters	▪ Additive selection method [63,0,102] ▪ New recipe selection [63,0,10] → [63,0,118] ▪ Suggested additive method [63,0,170] ▪ Forced additive selection bitmap [63,0,60] → [63,0,112] ▪ No. of additives [63,0,100] ▪ Number of data items [63,0,186] ▪ Data items [63,0,188;190;192;194;196]
Results	When transaction gets authorized, the system assigns it a transaction sequence number [63,0,124]. In auto operating mode, the configuration parameters are locked when transaction is authorized.

End Transaction [0x07]

Ends a transaction if a transaction is authorized. If a transaction **is** in progress and the DL8000 archive module is running, then the system archives the transaction and displays “Archiving Transaction” and “Please Wait” messages before ending the transaction. If the transaction **is not** in progress (that is, not a single batch is delivered in this transaction), then the transaction aborts. DL8000 displays a “Please wait” message until it receives the next command.

If an operator presses **Stop** while a transaction is in progress **and** the batch is not in progress **or** the batch is stopped, then the DL8000 sets the Transaction End Requested flag (bit 19 in [63,0,119]) to indicate the request for a transaction end. The TAS then can issue an End Transaction command.

Flags Immediately Set	Transaction Ended
Flags Immediately Cleared	▪ Transaction in Progress ▪ Transaction Authorized ▪ Transaction End Requested
Exceptions	▪ Batch in Progress ▪ Operating Mode is Manual ▪ No transaction authorized
Supporting Parameters	None
Results	The transaction ends; if the transaction aborts without delivering a single batch, the system **reduces** the transaction sequence number [63,0,124] by one.

Prompt Preset Volume [0x08]

Allows the TAS to let an operator enter a preset volume at the keypad. Issuing this command locks the keypad and display to the TAS. The DL8000 displays a preset selection screen. If the suggested preset volume [63,0,185] is greater than zero, the DL8000 “pre-types” the suggested preset volume. The operator can press **Enter** to accept displayed preset volume or press **Alt + Backspace** to enter another preset volume.

The operator must enter the preset within the timeout time [63,0,171]; otherwise the operation aborts and sets the Operation Timed Out flag (bit 3 in [63,0,119]).

If you set the timeout to zero, then the timeout doesn’t occur. You must then use the Timeout Operation command (0x05) to end this operation.

Flags Immediately Set	K&D Locked Out
Flags Immediately Cleared	▪ Operation Timed Out ▪ Preset Volume Entered
Exceptions	▪ Passcode Entry in Progress ▪ Batch in Progress ▪ Primary Alarm active ▪ Operating Mode is Manual ▪ No transaction authorized ▪ K&D Locked Out
Supporting Parameters	▪ Suggested preset volume [63,0,185] ▪ Preset volume entered [63,0,39]

Prompt Preset Volume [0x08]

Results	When an operator enters the preset value, the DL8000 sets the Preset Volume Entered flag (bit 6 in [63,0,119]). A Prompt Preset Volume [0x08] command, Authorize Batch [0x0A] command, or a Clear Status [0x13] command clears this flag. After this the DL8000 displays the messages “Please Wait” and either “Preset Entered” or "Timeout Operation" (depending on the time out activity) and waits for a command. The TAS can read preset volume entered [63,0,39] using Modbus read function code.

Authorize Batch [0x0A]

Authorizes the batch for given preset volume [63,0,39]. When the batch authorizes, the DL8000 displays a loading screen. This also increments the batch sequence number [63,0,125] by **1** (which may roll from 9999 to 0) to indicate the prospective sequence number if the batch starts.

The operator must start loading within the timeout time [63,0,171]; otherwise the system sets the Operation Timed Out flag and automatically aborts the batch.

Flags Immediately Set	▪ K&D Locked Out ▪ Batch Authorized
Flags Immediately Cleared	▪ Preset Volume Entered ▪ Operation Timed Out ▪ Batch Ended ▪ Batch Aborted ▪ Batch Stopped ▪ Batch in Progress
Exceptions	▪ Passcode Entry in Progress ▪ Primary Alarm active ▪ Batch Authorized ▪ No transaction authorized ▪ Operating Mode is Manual ▪ K&D Locked Out ▪ Invalid preset volume ▪ Maximum batches delivered for transaction ▪ Maximum Transaction Total (0x5F) ▪ Tolerance error (0x5B) ▪ Flow Rate Too Low/High
Supporting Parameters	▪ Preset Volume Entered [63,0,39] ▪ Timeout time [63,0,171]

Authorize Batch [0x0A]

Results	When the batch authorizes, the DL8000 displays a loading screen. The DL8000 “presets the batch” and displays "Start to Load” and “Stop to Abort" messages. The operator must press **Start** to initiate loading within the timeout time [63,0,171]. If the batch aborts (that is, the operator presses **Stop** instead of **Start** or the DL8000 times out waiting for the **Start** key to be pressed), the DL8000 sets the Batch Aborted and Operation Timed Out flags (bits 14 and 3 in [63,0,119]) and resets the Batch Authorized flag (bit 17 in [63,0,119]). This also decreases by **1** the system-assigned batch sequence number [63,0,125].

End Batch [0x0D]

Ends an in-progress batch which has halted or aborts an authorized batch which has not yet started.

Under normal circumstances, a batch ends itself when the preset volume of all the components in the blend or recipe has been delivered.

The End Batch command is **not** the same as the Stop Batch command [0x0F]. The Stop Batch command simulates the Stop key being pressed, which potentially allows the batch to be restarted.

You can also end the batch by pressing **Stop** when the batch is halted without any active alarm having severity more than info.

Flags Immediately Set	▪ Batch Ended (if batch was in progress) **or** ▪ Batch Aborted (if batch was not in progress)
Flags Immediately Cleared	▪ Batch In Progress ▪ Batch Stopped ▪ Batch Authorized ▪ K&D Locked Out
Exceptions	▪ No batch is authorized ▪ Batch is in progress but not stopped (No batch halted exception) ▪ Operating mode is manual
Supporting Parameters	None

End Batch [0x0D]

Results	If batch ends, the DL8000 sets the Batch Ended flag to indicate that the batch has ended (which implies it cannot be restarted). If the archive module is running, then before ending the batch the system archives batch data and displays an "Archiving Batch" and “Please Wait” messages. After completing the archiving, the DL8000 displays a “Please Wait” message and waits for a command from the TAS. Setting the Batch Ended flag signals the TAS to request batch data. If the batch aborts, the DL8000 sets the Batch Aborted flag, decreases by **1** the batch sequence number [63,0,125], and does not perform archiving. The DL8000 then displays a “Please Wait” message and waits for the next TAS command. The TAS can also use a Timeout Operation command [0x05] to abort a batch. Use the Clear Status [0x13] command to clear the Batch Ended and Batch Aborted flags.

Start/Restart Batch [0x0E]

Starts a new batch that has been authorized but not in progress. You can also use this command to restart a batch in progress that has been stopped. To start a new batch, it must have been previously authorized using the Authorize Batch command [0x0A]. The batch must be halted without any active alarm having severity more than info for restarting a halted batch.

Use this command to “remote control” a DL8000 when an operator cannot be in the proximity of the DL8000. In these circumstances the TAS can entirely control the DL8000, which may not even be fitted with a display or keypad.

Flags Immediately Set	Batch in Progress
Flags Immediately Cleared	Batch Stopped
Exceptions	▪ Primary Alarm active ▪ Active alarm with severity more then info but less than primary (Alarm active exception - 0x5C) ▪ No batch is authorized ▪ No batch stopped ▪ Operating Mode is Manual
Supporting Parameters	None
Results	The DL8000 starts batch delivery (this is same as pressing **Start**).

Stop Batch [0x0F]

Stops a batch which is in progress and is not stopped. This simulates pressing **Stop** on the DL8000 preset.

The **Stop** key [63,0,61] action determines the manner in which the batch stops:

- If no active alarm with more than info severity is present and batch remaining quantity [63,0,3] is less than minimum preset quantity [63,0,27] then batch ends.
- If Stop key action is Low Flow (0), the system waits for flow rate to become zero before starting pump stop delay timer for closing the pump.
- If Stop key action is Immediate (1), then batch is stopped immediately and no pump stop delay used.

The DL8000 sets a flag to indicate that the batch has stopped (and is restartable).

Flags Immediately Set	▪ Batch Stopped (if batch gets stopped) **or** ▪ Batch Ended (if batch is ended)
Flags Immediately Cleared	None
Exceptions	▪ No batch in progress ▪ Manual operating mode
Supporting Parameters	Stop key action [63,0,61]
Results	If the batch halts then the DL8000 displays “Batch Halt” and “Start to Load” messages. If the batch has completed then the DL8000 displays “Batch Completed” and “Please Wait” messages. In both conditions, the DL8000 waits for the next command from the TAS.

Clear Status [0x13]

Allows the TAS to reset certain status flags. Copy status flags [63,0,172] indicates which flag should reset. If any bit is 1 in copy status flag then that flag resets when receiving this command. The following flags can be updated from the TAS:

- Operation Timed Out (0x03 bit)
- Recipe Selected (0x04 bit)
- Additive Selected (0x05 bit)
- Preset Volume Entered (0x06 bit)
- Keypad Data Available (0x07 bit)
- Program Code Value Changed (0x08 bit)
- Key Pressed (0x0B bit)
- Transaction Ended (0x0C bit)
- Batch Ended (0x0D bit)
- Batch Aborted (0x0E bit)
- Transaction End Requested (0x13 bit)
- Program Mode (0x16 bit)

When the DL8000 is in program mode, it can reset only the Program Mode flag; otherwise an exception occurs.

Note: If **any** of the flags requested to be reset are not allowed to be reset, then **no** flag resets out of those requested to be reset.

Flags Immediately Set	None
Flags Immediately Cleared	Any flags this command requests to be cleared
Exceptions	▪ Status cannot reset ▪ Operation mode is manual
Supporting Parameters	Copy status flags [63,0,172]
Results	Reset of status flags as requested by the command.

Reset Primary Alarms [0x14]

Allows the TAS to reset one or all primary active alarms. If the chronologically oldest active primary alarm resets, this command has the same effect as a primary reset alarm via the alarm reset screen. All primary alarms reset if the alarm ID is 0xFF; otherwise, only the primary alarm with given alarm ID [63,0,173] resets.

This command basically allows the TAS operator to reset the primary alarm “remotely” without requiring a “hands-on” log-in to program mode for the DL8000.

The system raises the “Unable to Reset Alarm” exception if it cannot reset the configuration corrupted alarm.

Note: If **all** active primary alarms are requested to be reset and **one** of the raised alarms has a configuration corrupted alarm, the system first attempts to reset this alarm. If successful, it resets all other alarms.

Only active primary alarms reset. Alarms with severity more than info [1] but less than primary [4] which do not allow a batch to be started are not reset.

Flags Immediately Set	None

Reset Primary Alarms [0x14]

Flags Immediately Cleared	Primary Alarm active (if all active primary alarms are cleared)
Exceptions	▪ Passcode Entry in Progress ▪ Operation in Manual Mode ▪ Invalid alarm ID ▪ Unable to reset the alarm (that is, alarm cannot be forcibly reset) – Exception 0x5E
Supporting Parameters	Reset alarm ID [63,0,173]
Results	As noted in description.

Display Message [0x1C]

Displays an informational message to operator or a prompt message to get some input data from operator.

If auxiliary data index [63,0,178] is non-zero and is less than or equal to the number of data items [63,0,186], then the DL8000 displays a prompt to the operator (using appropriate data prompt message [63,0,187;189;191;193;195]) to enter/request the appropriate data item before authorizing a new transaction.

If the transaction is not authorized and auxiliary data index [63,0,178] is between 6 to 10, then the DL8000 displays a informational message (using appropriate info prompt message [63,0,235;236;237;238;239]). This can be used at the end of transaction after it is ended.

Note: If transaction is not authorized and the Operation Timed Out flag is not set [63,0,119], then auxiliary data 1 to 5 [63,0,188;190;192;194;196] can be directly written, without issuing this command from TAS.

Flags Immediately Set	K&D Locked Out
Flags Immediately Cleared	▪ Operation Timed Out ▪ Keypad Data Available
Exceptions	▪ Passcode Entry in Progress ▪ Batch in Progress ▪ Primary Alarm active ▪ Operation in manual mode ▪ K&D locked out ▪ No string data to display ▪ Auxiliary data index [63,0,178] is zero (gives invalid number of data items exception) ▪ Auxiliary data index [63,0,178] is non-zero and transaction is authorized ▪ Auxiliary data index [63,0,178] is non-zero but is **greater** than the number of data items [63,0,186] and **less** than the maximum number of data items (5). ▪ Auxiliary data index [63,0,178] is non-zero and not between 6 to 10

Display Message [0x1C]

Supporting Parameters	▪ Timeout time [63,0,171] used in case of auxiliary data item display prompt, i.e. when auxiliary data index [63,0,178] less than Number of data items [63,0,186] ▪ Auxiliary data index indicates that which prompt should be displayed and which place user entry should be stored.
Results	The operator has to enter an auxiliary data item within the timeout time [63,0,171]; otherwise the operation aborts and sets the Operation Timed Out flag (bit 3 in [63,0,119]). If you set the timeout to zero, then the timeout doesn't occur. You must then use the Timeout Operation command (0x5) to end this operation. If timeout occurs then the DL8000 displays the message "Timeout Operation" and waits for next command from the TAS. When an operator enters an auxiliary data item, then the DL8000 clears the Operation Timed Out and the K&D Locked Out flags. It also sets the Keypad Data Available flag, which tells the TAS that the operator has entered data. The DL8000 displays a "Data Entered" message and waits for the next command from the TAS. After this the TAS can read data item [63,0,188;190;192;194;196] from the appropriate parameter based on auxiliary data item index [63,0,178].

Set Date and Time [0x29]

Sets the date and time (if transaction is not authorized in the DL8000) written in TA Set Time (63,0,174) to battery-backed real-time clock.

The date and time is written as a 4-byte integer and represents the number of seconds elapsed since January 1, 1970, at 12AM.

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	Transaction is authorized
Supporting Parameters	▪ Point type 136: ROC Clock ▪ TA Set Time (TLP 63,0,174)
Results	As above.

Reset Unit [0x30]

Initiates warm start of DL8000 (similar to power-up). This command restarts all user programs, but cannot be issued when a transaction is in progress.

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	▪ Transaction in Progress ▪ Weights and Measure locked
Supporting Parameters	None
Results	As above

Change Operating Mode [0x37]

Allows the TAS to change the DL8000's operating mode as written in the TAS's operating mode [63,0,180] with options (0=Auto, 1=Manual). If the DL8000 is already in the desired mode, the command is just acknowledged.

For Version 1.0: The mode does not change if the batch halts at alarm halt.
For Version 2.0: In auto mode, if the alarm raises the mode changes to manual and the current batch completes before ending the transaction.

If this command is issued and the current transaction is authorized, the DL8000 ends the current transaction. The operating mode does not change until the current transaction has ended.

Flags Immediately Set	Operating Mode is Manual (if new mode is manual)
Flags Immediately Cleared	▪ Operating Mode is Manual (if new mode is auto) ▪ Operation Timed Out ▪ Recipe Selected ▪ Additive Selected ▪ Preset Volume Entered ▪ Keypad Data Available ▪ K&D Locked Out
Exceptions	▪ No batch stopped ▪ Batch is in progress and any non primary alarm with severity more than info (1) is active. ▪ Batch is in progress and any primary alarm is active. ▪ Invalid operating mode
Supporting Parameters	TA operating mode [63,0,180]
Results	The DL8000 changes the operating mode as requested and displays a new screen according to the new mode.

Clear Display [0x38]

Clears the DL8000's multi-line display. Use this command to erase the contents of the recipe menu after a prompt recipe command, the contents of the additive menu after a prompt additive command, the contents of a loading screen after an authorized transaction command, or to clear a Prompt Preset Volume command or an Authorize Batch command.

Clear Display [0x38]

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	▪ Passcode Entry in Progress ▪ Operating Mode is Manual ▪ K&D Locked Out
Supporting Parameters	None
Results	Clear existing screen and display “Please wait” until next command is received. The alarm and date-time continue to display.

Report Alarm [0x3D]

Raises alarms based on reset alarm ID [63,0,173]. Possible uses of this command are:

- Raising an alarm based on conditions that are either not input to or not detectable by the DL8000 (such as a fire detection system or a PLC being used to monitor a rail car’s position).
- Stopping a batch with a situation-specific message. In this case, the TAS might configure a safety circuit alarm message via communications and then raise the corresponding safety circuit alarm. The TAS can reset the alarm using the reset primary alarms command [0x14].

Note: A TAS should **not** depend on DL8000 alarms to prevent or control hazardous or life-threatening conditions.

Flags Immediately Set	Primary Alarm (if primary alarm is raised)
Flags Immediately Cleared	None
Exceptions	▪ Invalid alarm ID ▪ Unable to set or reset alarm
Supporting Parameters	Reset alarm ID [63,0,173]
Results	Batch may stop due to reported alarm.

D.3.2 DanLoad 6000 Protocol Commands

The following table lists the DanLoad 6000 protocol commands, indicates which DanLoad 6000 protocol commands the DL8000 supports, designates the operating mode (automatic or manual) in which the command is valid, and notes which commands which are purely read or write.

Table D-2. DanLoad 6000 Commands

Cmd No (decimal)	Cmd No (hex)	Command Name	Valid modes (Automatic/Manual)	Command supported	Type
1	1	Prompt Recipe	A	Yes	
2	2	Request Selected Recipe	A	Yes	Read
3	3	Prompt Additives	A	Yes	
4	4	Request Selected Additive	A	Yes	Read
5	5	Timeout Operation	A	Yes	
6	6	Authorize Transaction	A	Yes	
7	7	End Transaction	A	Yes	
8	8	Prompt Preset Volume	A	Yes	
9	9	Request Preset Volume	A	Yes	Read
10	A	Authorize Batch	A	Yes	
11	B	Set Densities/Gravities	A	Yes	Write
12	C	Set Temperature	A	No	
13	D	End Batch	A	Yes	
14	E	Start/Restart Batch	A	Yes	
15	F	Stop Batch	A	Yes	
16	10	Batch Data by Component	A	Yes	Read
17	11	Additive Totalizer	A/M	Yes	Read
18	12	Request Status	A/M	Yes	Read
19	13	Clear Status	A	Yes	
20	14	Reset Primary Alarms	A	Yes	
21	15	Meter Totalizers	A/M	Yes	Read
22	16	Component Totalizers	A/M	Yes	Read
23	17	Unauthorized Flow	A/M	Yes	Read
24	18	Data code value	A/M	No	
25	19	Request Meter Values	A/M	Yes	Read
26	1A	Request Component Value	A/M	Yes	Read
27	1B	Request Power Fail Date and time	A/M	Yes	Read
28	1C	Display Message	A	Yes	
29	1D	Request keypad data	A	Yes	Read
30	1E	Request Transaction Storage Status	A/M	Yes	Read

Cmd No (decimal)	Cmd No (hex)	Command Name	Valid modes (Automatic/Manual)	Command supported	Type
31	1F	Transaction data by component	A/M	Yes	Read
32	20	Initialize Transaction Storage	A/M	Yes	
33	21	Start Communication	A/M	Yes	
34	22	Request program code values and attributes	A/M	Yes	Read
35	23	Set program code value	A	Yes	Write
36	24	Modify program code attribute	A	No	
37	25	Request value changed attributes	A	No	
38	26	Clear value changed attributes	A	No	
39	27	Configure recipe	A	Yes	Write
40	28	Get Date and Time	A/M	Yes	Read
41	29	Set Date and Time	A/M	Yes	Write
42	2A	Request firmware version	A/M	Yes	Read
43	2B	Read input	A/M	No	
44	2C	Write output	A/M	No	
45	2D	DUART Diagnostic	A/M	No	
46	2E	ARCNET Diagnostic	A/M	No	
47	2F	Request crash data	A/M	No	
48	30	Reset Unit	A/M	Yes	
49	31	Last key pressed	A/M	Yes	
50	32	RAM Tests	A/M	No	
51	33	Swing arm side	A/M	Yes	Read (only for version 2.0 and later)
52	34	Installed boards	A/M	No	
53	35	Configure	A/M	No	
54	36	Weight & Measure Switch	A/M	Yes	Read
55	37	Change operating mode	A/M	Yes	
56	38	Clear display	A	Yes	
57	39	Request stored transaction	A/M	Yes	
58	3A	Request stored batch	A/M	Yes	
59	3B	Enhanced Start Communications	A/M	Yes	Read
60	3C	Enhanced Request Status	A/M	Yes	Read
61	3D	Report Alarm	A/M	Yes	

The DanLoad 6000 protocol contains all the data required to execute the command in the command request frame. However, some differences

(or "deviations") exist in the manner in which the DL8000 handles the DanLoad 6000 protocol. Refer to the "Deviation" heading under the command descriptions. Additionally, the DL8000 does not support some of the exception codes in the DanLoad 6000 protocol **and** some new exception codes have been added to the protocol to support the DL8000. Refer to *Sections D.9* and *D.10* for lists of new and unused exception codes.

Note: Refer to the *DanLoad 6000 Communications Specifications Manual* (Part Number 3-9000-674, Revision 2.1, publication date September 1998) for a definitive discussion of commands and request and response frames for the DanLoad 6000 protocol.

Prompt Recipe [0x01]

Enables an operator to select a recipe at the DL8000. The TAS is locked out of the keypad and display.

The DL8000 displays a recipe selection screen to operator on which the recipe names display starting from first recipe up to the number of recipes [63,0,26] configured. The operator has to select a recipe within the timeout time specified in the frame; otherwise the operation aborts and sets the Operation Timed Out flag (bit 3 in [63,0,119]). If a timeout occurs, further recipe selection is blocked.

Note: In the DanLoad 6000 protocol, the timeout parameter is included in the frame; there is no need to specific the TLP.

If you set the timeout to zero, then the timeout doesn't occur. You must then use the Timeout Operation command (0x05) to end this operation.

The TAS can change the recipe selection by writing its own value when it issues an Authorize Transaction command (0x06).

Flags Immediately Set	K&D Locked Out
Flags Immediately Cleared	▪ Operation Timed Out ▪ Recipe Selected
Exceptions	▪ Transaction Authorized ▪ K&D Locked Out ▪ Primary Alarm ▪ Operating Mode is Manual ▪ Passcode Entry in Progress
Supporting Parameters	None
Results	When an operator selects a recipe, the DL8000 sets the Recipe Selected flag (bit 4 in [63,0,119]) which tells the TAS that it can read the selected recipe.
Deviations	None

Request Selected Recipe [0x02]

Enables the TAS–once the DL8000 protocol sets the Recipe Selected flag (bit 4 in [63,0,119]), indicating that an operator has selected a recipe—to request the selected recipe using this command.

Flags Immediately Set	None

Request Selected Recipe [0x02]

Flags Immediately Cleared	None
Exceptions	▪ Primary Alarm ▪ No Recipe Selected ▪ Operating Mode is Manual
Supporting Parameters	As above
Results	None
Deviations	None

Prompt Additives [0x03]

Enables an operator to select additives at the keypad. The TAS is locked out of the keypad and display.

The DL8000 displays an additive selection screen with the suggested additive selection received in command request frame. The suggested additive selection can be “no additives/” The operator has to select an additive within timeout time received in the command; otherwise, the operation aborts and sets the Operation Timed Out flag (bit 3 in [63,0,119]).

If you set the timeout to zero, then the timeout doesn’t occur. You must then use the Timeout Operation command (0x05) to end this operation.

This command does not result in an additive selection being set in the DL8000. It just enables the TAS to obtain a possible additive selection from an operator at the DL8000. The TAS can set the additive selection using the Authorize Transaction command.

Flags Immediately Set	K&D Locked Out
Flags Immediately Cleared	▪ Operation Timed Out ▪ Additive Selected
Exceptions	▪ Passcode Entry in Progress ▪ Primary Alarm ▪ Transaction Authorized ▪ Operating Mode is Manual ▪ K&D Locked Out ▪ Additive selection method [63,0,102] is not prompt ▪ Number of additives [63,0,100] is zero ▪ Dependent user program is not in running state in Preset.
Supporting Parameters	None
Results	When operator selects additive, DL8000 sets Additive Selected flag (bit 5 in [63,0,119]) to indicate that the TAS can read the selected additive.

Prompt Additives [0x03]	**Deviations**	▪ Does not support the Transaction in Progress exception. ▪ Supports additional exceptions such as Invalid Additive Selection Method and Module Not Loaded. ▪ Supports additional exception Passcode Entry in Progress.

Request Selected Additives [0x04]

Enables the TAS to request—once the DL8000 sets the additive flag (bit 5 in [63,0,119]) to indicate that the operator has selected additives—the selected additive using this command. The TAS specifies an additive selection in the Authorize Transaction command. This can be the operator-selected additive or an additive the TAS determines independently of the operator's selection.

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	▪ Primary Alarm ▪ Transaction Authorized ▪ Operating Mode is Manual ▪ No additive selection made ▪ Dependent user program is not in running state in Preset
Supporting Parameters	As above
Results	None
Deviations	▪ Gives additional exception code (Dependent user program is not in running state in Preset) not present in original DanLoad 6000 protocol.

Timeout Operation [0x05]

If this command is issued when the DL8000 is prompting for a recipe, for additives, for a preset volume, or for keypad input; displaying a message; or waiting for the operator to start or abort a batch, then the current operation times out. The DL8000 displays "Timeout Operation" and "Please wait" messages.

If the timeout time received with the earlier prompt or display command equals zero, then the TAS can terminate a user prompt command or display message command by issuing a Timeout Operation command.

Flags Immediately Set	Operation Timed Out
Flags Immediately Cleared	K&D Locked Out
Exceptions	▪ Batch in Progress ▪ Operating Mode is Manual ▪ Passcode Entry in Progress
Supporting Parameters	None

Timeout Operation [0x05]

Results	If DL8000 is displaying any prompt or message then the current operation times out. DL8000 displays "Timeout Operation" and “Please wait” messages.
Deviations	Clears K&D Locked Out flag.

Authorize Transaction [0x06]

Authorizes transaction with selected recipe [63,0,118], additive [63,0,112], and data items [63,0,188;190;192;194;196]. The TAS can override the operator selection and provide a new recipe, additive, or data items as part of this command. DL8000 displays the “Transaction Auth” and “Please Wait” messages.

Note: The TAS can read user-entered data items using the Display Message command (0x1C).

Flags Immediately Set	Transaction Authorized
Flags Immediately Cleared	▪ Recipe Selected ▪ Additive Selected ▪ Transaction Ended ▪ Transaction End Requested ▪ Transaction in Progress

Authorize Transaction [0x06]

Exceptions	▪ Passcode Entry in Progress ▪ Primary Alarm ▪ Transaction Authorized ▪ Operating Mode is Manual ▪ K&D Locked Out ▪ Invalid recipe number (Recipe selected [63,0,10] is more than number of recipes [63,0,26]) ▪ No recipe selected ▪ Invalid additive selection method [63,0,102] ▪ Invalid additive selection ▪ Recipe verification fail ▪ Additive user program is not running in DL8000 and suggested additive method received is 0 and forced additive bitmap received is non-zero. ▪ Additives module is running in DL8000 and suggested additive selection method received is not 0 or 1. Returns Invalid additive selection method exception. ▪ Suggested additive method received is 0 and additive bitmap [63,0,112] set more than configured number of additives [63,0,100]. ▪ Invalid Swing Arm Side ▪ Invalid number of data prompts ▪ Invalid additive selection method ▪ Suggested additive method received is 1 and additive bitmap picked up as per the additive selection method has additive bits set more than configured number of additives [63,0,100].
Supporting Parameters	▪ New recipe selected [63,0,118] ▪ Suggested additive method [63,0,170] ▪ Forced additive selection bitmap [63,0,112] ▪ Number of additives [63,0,100] ▪ Number of data items [63,0,186] ▪ Data items [63,0,188;190;192;194;196] ▪ Additive Selection Method [63,0,102]
Results	When a transaction is authorized, the system assigns it a transaction sequence number [63,0,124]. All the configuration parameters are locked when transaction is authorized.
Deviations	Additional exceptions supported: ▪ Recipe Verification Fail ▪ No Recipe Selected

End Transaction [0x07]

Ends an authorized transaction. If the transaction is in progress and the DL8000 archive module is running, then the system archives the transaction before ending the transaction. If transaction is not in progress (that is, not a single batch is delivered in this transaction), then the transaction aborts. The DL8000 displays “Trans Ended” and “Please wait” messages until it receives the next command.

If an operator presses **Stop** when transaction is in progress and the batch is not in progress, then the DL8000 sets the Transaction End Requested flag (bit 19 in [63,0,119]).

Flags Immediately Set	Transaction Ended
Flags Immediately Cleared	▪ Transaction in Progress ▪ Transaction Authorized ▪ Transaction End Requested
Exceptions	▪ Batch in progress ▪ Operating mode is manual ▪ No transaction authorized ▪ Invalid swing arm side (applicable only for Version 2.0 and later)
Supporting Parameters	None
Results	The transaction ends. If the transaction aborts without delivering a single batch then the system reduces the transaction number [63,0,124] by **1**.
Deviations	In the DanLoad 6000 preset, this command can only be used to end transactions in progress. The DL8000 can end both transactions in progress and those not in progress.

Prompt Preset Volume [0x08]

Enables an operator to enter a preset volume at the keypad. Once the command is issued, the TAS is locked out of the keypad and display. The DL8000 displays a preset selection screen. If the suggested preset volume received is greater than zero, the DL8000 “pre-types” the suggested preset volume. The operator can either press **Enter** to accept the displayed preset volume or press **Clear** to enter another preset volume.

If the override maximum preset volume is greater than zero, the DL8000 ensures that the preset volume is less than or equal to the minimum of the configured maximum preset volume and override maximum preset volume defined in the Prompt Preset Volume command. This command does not modify the configured maximum preset volume.

The operator must enter the preset volume within the timeout time; otherwise the operation aborts and sets the Operation Timed Out flag (bit 3 in [63,0,119]).

If you set the timeout to zero, then the timeout doesn’t occur. You must then use the Timeout Operation command (0x05) to end this operation.

Flags Immediately Set	K&D Locked Out
Flags Immediately Cleared	▪ Operation Timed Out ▪ Preset Volume Selected

Prompt Preset Volume [0x08]	**Exceptions**	▪ Passcode Entry in Progress ▪ Batch in Progress ▪ Primary Alarm ▪ Operation in Mode is Manual ▪ No transaction authorized ▪ K&D Locked Out ▪ Invalid Preset Volume
	Supporting Parameters	▪ Suggested preset volume [63,0,185] ▪ New preset volume [63,0,39] ▪ Maximum preset quantity [63,0,28]
	Results	When the operator enters a preset volume, that sets the Preset Volume Entered flag (bit 6 in [63,0,119]). A Prompt Preset Volume [0x08], Authorize Batch [0x0A], or Clear Status [0x13] command clears the Preset Volume Entered flag. It also reset previous preset value [63,0,39]. After this the DL8000 displays a “Please wait” and “Preset Entered” or “Timeout Operation” messages and waits for the next command.
	Deviations	None.

Request Preset Volume [0x09]	Once an operator enters a preset volume, the DL8000 sets the Preset Volume Entered flag. The TAS uses the Request Preset Volume command to request that preset volume, as well as further validate the operator-entered preset volume, and sets the volume in the DL8000 using the Authorize Batch [0x0A] command.	
	Flags Immediately Set	None
	Flags Immediately Cleared	None
	Exceptions	▪ Primary Alarm ▪ Operating Mode is Manual ▪ No preset volume entered
	Supporting Parameters	None
	Results	None
	Deviations	None

Authorize Batch [0x0A]	Authorizes a batch for the preset volume received with this command. When the batch is authorized, the DL8000 displays a loading screen. This also increments the batch sequence number [63,0,125] by **1** (which rolls from 9999 to 0) indicating the prospective sequence number if the batch starts. Operator has to initiate loading within timeout time received with the command; otherwise the batch aborts and sets the Operation Timed Out flag.	
	Flags Immediately Set	▪ K&D Locked Out ▪ Batch Authorized

Authorize Batch [0x0A]

Flags Immediately Cleared	▪ Preset Volume Entered ▪ Operation Timed Out ▪ Batch Ended ▪ Batch Aborted ▪ Batch Stopped ▪ Batch in Progress
Exceptions	▪ Passcode Entry in Progress ▪ Primary Alarm ▪ Batch Authorized ▪ No transaction authorized ▪ Operating Mode is Manual ▪ K&D Locked Out ▪ Invalid Preset volume ▪ Flow Rate Too High/Low ▪ Invalid Number of Components ▪ Maximum Batches Delivered for Transaction (0x57) ▪ Maximum Transaction Total (0x5F) ▪ Tolerance error (0x5B)
Supporting Parameters	▪ Preset volume entered [63,0,39] ▪ Timeout time [63,0,171]
Results	When the batch authorizes, the DL8000 displays a loading screen. The DL8000 presets the batch and displays "Start to Load" and "Stop to Abort" messages. The operator has to initiate loading by pressing **Start** within the timeout time [63,0,171]. If the batch aborts (that is, the operator presses **Stop** instead of **Start** or the DL8000 times out waiting for the **Start** key to be pressed), the DL8000 sets the Batch Aborted and Operation Timed Out flags (bits 14 and 3) and resets the Batch Authorized flag (bit 17 in [63,0,119]). This also reduces by **1** the batch sequence number [63,0,125].
Deviations	▪ Does not support exceptions "Program Code Value is Weights & Measures" and "Program Code is Read-only." ▪ Does not use the backup density, backup gravity, or backup temperature for all batch components sent in the DanLoad 6000 command frame. If the TAS tries to set the backup density using this command, the DL8000 updates the base density of the corresponding product. ▪ Exception codes [0x57], [0x5B], and [0x5F] are not available in the original DanLoad 6000 protocol. ▪ Supports additional exception Flow Rate Too High/Low

Set Densities/Gravity [0x0B]

Sets the density/gravity for all the products/components in the batch prior to authorizing a batch. If the use_gord flag received for each component in the command request frame is set to 1, then value of density/gravity is set to product base density [72,x,8]. The units of gravity or density should be same as those configured in the DL8000 at parameter Density Units Option [70,0,3].

If there is an online input to the TAS, update the backup densities or gravities using the Authorize Batch [0x0A] command. If these values are provided manually, use the Set Densities/Gravity command to send the updated density or gravity values to the DL8000.

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	▪ Primary Alarm ▪ Batch Authorized ▪ Operating Mode is Manual ▪ Invalid program code value ▪ Invalid number of component
Supporting Parameters	Product base density [72,x,8]
Results	None
Deviations	▪ Does not support exceptions “Program Code Value is Weights & Measures” and “Program Code is Read-only.” ▪ If TAS tries to set the backup density using this command, the DL8000 updates the base density of the corresponding product.

End Batch [0x0D]

Ends an in-progress batch which has halted or aborts an authorized batch which has not started.

Under normal circumstances a batch ends itself when the preset volume of all the components in the blend or recipe has been delivered.

The End Batch command is **not** the same as the Stop Batch command [0x0F]. The Stop Batch command simulates the Stop key being pressed, which potentially allows the batch to be restarted.

You can also end a batch by pressing **Stop** when the batch is halted without any active alarm having severity more than info.

Flags Immediately Set	▪ Batch Ended (if batch was in progress) **or** ▪ Batch Aborted (if batch was not in progress)
Flags Immediately Cleared	▪ Batch in Progress ▪ Batch Stopped ▪ Batch Authorized ▪ K&D Locked Out

End Batch [0x0D]

Exceptions	▪ No batch is authorized ▪ Batch is in progress but not stopped (No batch halted exception) ▪ Manual operation mode
Supporting Parameters	None
Results	If batch ends, the DL8000 sets the Batch Ended flag to indicate that the batch has ended (which implies that the batch cannot be restarted). If archive module is running, it archives the batch data before ending the batch, displaying "Archiving Batch" and “Please wait” messages. After archiving completes, the DL8000 displays a “Please wait” message and waits for the next TAS command. Setting the Batch Ended flag signals the TAS to request batch data. If the batch aborts, the DL8000 sets the Batch Aborted flag, reduces by **1** the batch sequence number [63,0,125], and does not perform archiving. The DL8000 then displays a “Please wait” message and waits for the next TAS command. The TAS can also use a Timeout Operation command [0x05] to abort a batch Clear the Batch Ended and Batch Aborted flags using the Clear Status command [0x13].
Deviations	▪ The original DanLoad 6000 protocol does not support aborting a batch using the End Batch command. ▪ Implements a No Batch is Authorized exception in place of the No Batch in Progress. Also implements exceptions for Batch in Progress but Not Stopped.

Start/Restart Batch [0x0E]

Starts a new batch that has been authorized but is not in progress or restarts a batch in progress that has been stopped. A batch must have been previously authorized using the Authorize Batch command [0x0A] in order to start a new batch. For restarting a halted batch, the batch must be halted without any active alarm having severity more than info.

Use this command to “remote control” a DL8000 when an operator cannot be in the proximity of the DL8000. In these circumstances the TAS can entirely control the DL8000, which may not even be fitted with a display or keypad.

Flags Immediately Set	Batch in Progress
Flags Immediately Cleared	Batch Stopped

Start/Restart Batch [0x0E]	**Exceptions**	▪ Primary Alarm active ▪ Active alarm with severity more then info but less than primary (Alarm active exception - 0x5C) ▪ No batch is authorized ▪ No batch stopped ▪ Manual operating mode
	Supporting Parameters	None
	Results	The DL8000 starts delivering the batch (this is the same as pressing **Start**).
	Deviations	Supports additional exceptions such as no batch stopped and non primary alarm is active

Stop Batch [0x0F]

Stops a batch which is in progress and has not yet stopped. This simulates pressing **Stop**.

The manner in which the batch stops is determined by the Stop key action [63,0,61]:

- If no active alarm with more than info severity is present and the batch remaining quantity [63,0,3] is less than minimum preset quantity [63,0,27] then the batch ends.
- If **Stop** key action is Low Flow (0], then the system waits for the flow rate to become zero before starting pump stop delay timer for closing the pump.
- If **Stop** key action is Immediate (1), then the batch stops immediately without using a pump stop delay.

The DL8000 sets a flag to indicate that the batch has stopped (and is restartable).

Flags Immediately Set	▪ Batch Stopped (if batch gets stopped) **or** ▪ Batch Ended (if batch is ended)
Flags Immediately Cleared	None
Exceptions	▪ No batch in progress ▪ Operating Mode is Manual
Supporting Parameters	**Stop** key action [63,0,61]
Results	If batch halts, the DL8000 displays "Batch Halt" and “Start to Load” messages. If batch is complete, the DL8000 displays “Batch Completed” and “Please Wait” messages. In both conditions, the DL8000 waits for the next command from the TAS.
Deviations	None

Batch Data by Component [0x10]

Once a batch ends, the DL8000 sets a flag to indicate that the batch has ended and cannot be restarted. The TAS system can then use this command to request the data for the batch.

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	▪ Operating Mode is Manual ▪ No batch is ended
Supporting Parameters	Preset delivery type [63,0,29]
Results	The response frame includes the following parameter values: ▪ Batch sequence number [63,0,125] ▪ Transaction sequence number [63,0,124] ▪ Recipe number [63,0,118] ▪ Current swing arm side [63,0,145] (applicable only for Version 2.0 and later) ▪ Batch start date and time [63,0,232] ▪ Batch end date and time [63,0,233] ▪ Number of meters [63,0,20] ▪ Number of components [63,0,21] ▪ Number of additives [63,0,100] ▪ Number of data prompts [63,0,186] ▪ Meter Gross Batch start total snapshot [75,x,40] ▪ Meter Net std or Mass Batch start total snapshot [75,x,41 or 42] based on delivery type ▪ Meter Gross Batch end total snapshot [75,x,43] ▪ Meter Net std or Mass Batch end total snapshot [75,x,44 or 45] based on delivery type ▪ Component Gross Batch Totals [69,x,25] ▪ Component Net std or Mass Batch Totals [69,x,27 or 28] ▪ Component Avg (FWA) Batch Temperature [69,x,61] ▪ Component Avg (FWA) Batch Density [69,x,100] ▪ Component Avg (FWA) Batch Pressure [69,x,72] ▪ Actual component % in batch [69,x,59] ▪ Additive Batch totals [67,x,13] ▪ Data items entered [63,0,188;190;192;194;196]

Batch Data by Component [0x10]	**Deviations**	For **Version 1.0**: DL8000 does not support swing side arm, so it always returns a value of 1 in the command response frame. For **Version 2.0**: None

Additive Totalizer [0x11]	Displays the free running totals of all additives according to the configured number of additives.	
	Flags Immediately Set	None
	Flags Immediately Cleared	None
	Exceptions	Additives Module is not running in preset.
	Supporting Parameters	As below.
	Results	The response frame includes the following parameter values: ▪ Number of additives [63,0,100] ▪ Additive free running totals [67,x,12]
	Deviations	None

Request Status [0x12]	Displays the overall status of the DL8000. For the command response, see the Results section. Status flags is a binary representation of the DL8000's 32 status flags. Safety circuit status is the current logical state ("open" or "closed") of 8 general purpose safety circuit inputs. The least significant bit is safety circuit 1 etc. If you do not configure the safety circuit input then value of bit for respective safety circuit will be equal to unsafe state [0]. Alarm bitmaps indicate active (raised and not reset) alarms. The automation system can maintain a copy of the "alarm bytes" so that it can determine (for logging purposes) when alarms are raised or cleared.	
	Flags Immediately Set	None
	Flags Immediately Cleared	None
	Exceptions	None
	Supporting Parameters	As below

Request Status [0x12]

Results

The response frame includes the following parameter values:

- Status flags [63,0,119]
- Current swing arm side [63,0,145] (only for version 2.0 and later)
- Batch gross volume [63,0,135] or Composite Batch gross volume [63,0,2] based on Preset Additive Option [64,0,26] is set as “Exclusive” or “Inclusive” respectively.

  Note: Composite Gross available only for version 2.0 and later.
- Batch Net Standard [63,0,137] or Batch Mass [63,0,138] based on delivery type.
- Status of safety circuit inputs [63,0,98]

  Note: If you do not configure a safety circuit, the status of that circuit becomes **0**.
- Alarm ID of oldest highest priority active alarm [63,0,111] – returned alarm code is in terms of DanLoad 6000. Value stored at this parameter is alarm code used by DL8000 which may not match with alarm code of DanLoad 6000.
- Alarm bitmaps of ten bytes (returned in terms of DanLoad 6000 alarm bytes)

Deviations

- For the DanLoad 6000 protocol, alarm bitmaps of ten bytes returned contain only the status of primary alarms. However, the DL8000 returns the status of active alarms regardless of alarm severity.
- The DanLoad 6000 protocol can be used only on a single port and only on Comm A.
- Swing arm side is not supported in DL8000, so it always returns a value of **1** in the command response frame (valid **only** for version 1.0).
- Preset Additive Option [64,0,26] is an additional feature not available in the DanLoad 6000 protocol. (Valid only for Version 2.0 and later)

Clear Status [0x13]

Allows the TAS to reset certain status flags as requested by a Copy Status flag received in the command request frame identifying the flag to reset. If any bit in the Copy Status flag is 1, the system resets that flag when receiving this command. The TAS can update the following flags:

- Operation time out (0x03 bit)
- Recipe Selected (0x04 bit)
- Additives Selected (0x05 bit)
- Preset Volume Entered (0x06 bit)
- Keypad data available (0x07 bit).
- Program code value changed (0x08 bit).
- Key pressed (0x0B bit)
- Transaction Ended (0x0C bit)
- Batch Ended (0x0D bit)
- Batch Aborted (0x0E bit)
- Transaction end requested (0x13 bit)
- Program mode (0x16 bit)

Flags Immediately Set	None
Flags Immediately Cleared	Flags this command requests to be cleared.
Exceptions	▪ Status can not reset ▪ Manual operation mode
Supporting Parameters	None
Results	Reset of status flags as this command requests.
Deviations	None

Reset Primary Alarms [0x14]

Resets multiple active primary alarms. If the chronologically oldest active primary alarm is reset, this command has the same effect as a primary reset alarm via the alarm reset screen.

This enables the TAS operator to automatically reset the primary alarm “remotely” without requiring a DL8000 operator logging into program mode.

The system raises an Unable exception if it is unable to reset the alarm (that is, a configuration-corrupted alarm cannot be reset if count of corrupt configuration parameters [63,0,2] is more than 0.)

Flags Immediately Set	None
Flags Immediately Cleared	Primary Alarm active (if all active primary alarms are cleared)
Exceptions	▪ Passcode Entry in Progress ▪ Manual operation mode ▪ Invalid alarm ID ▪ Unable to reset the alarm (that is, alarm can’t be forcibly reset) – Exception 0x5E
Supporting Parameters	As above
Results	None

Reset Primary Alarms [0x14]

Deviations	▪ Some DL8000 alarms may not map directly to DanLoad 6000 alarms. ▪ Additional exceptions are supported such as invalid alarm ID and Unable to reset the alarm. ▪ DL8000 allows reset of non-primary alarms; DanLoad 6000 allows reset of only primary alarms. ▪ Does not support the following DanLoad 6000 protocol alarms: • Data logging memory full • Memory Check Failure • Primary Display Failure • Secondary Display Failure • MPMC 1 and MPMC 2 Failure • Calibration Failure for all meters • Intermediate Level Input

Meter Totalizers [0x15]

Returns a non-resettable authorized flow from meter. In a blending configuration (where more than one component may flow though a meter), it is not always possible to determine which component generates unauthorized flow.

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	None
Supporting Parameters	Preset delivery type [63,0,29]
Results	The response frame includes the following parameter values: ▪ Number of meters [63,0,20] ▪ Meter Authorized Gross Total [75,x,15] ▪ Meter Authorized Net std or Mass Total [75,x,17 or 18] based on delivery type
Deviations	The original DanLoad 6000-supported command returns a snapshot of the free-running meter totals. The DL8000 command returns free-running authorized meter totals.

Component Totalizers [0x16]

Returns non resettable component totalizers. In a blending configuration (where more than one component may flow through a meter) it is not always possible to determine which component generates unauthorized flow.

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	None
Supporting Parameters	Preset delivery type [63,0,29]

Component Totalizers [0x15]	**Results**	The response frame includes the values of following parameters: ▪ Number of components [63,0,21] ▪ Component Gross Total [69,x,30] ▪ Component Net std or Mass Total [69,x,32 or 33] based on delivery type
	Deviations	None

Unauthorized Flow [0x17]	Reads free-running unauthorized meter totals. Unauthorized flow (flow when the flow control valve has not been commanded to open) accumulates for each meter. Unauthorized flow is **not** included in the individual component totalizers. The TAS can request unauthorized flow "between batches" (that is, just before authorizing a batch) and during "end of day" processing. Requesting unauthorized flow does not zero out an unauthorized flow counter or reset an unauthorized flow alarm. (Use the Reset Primary Alarms command to reset an unauthorized flow alarm or reset the alarm at the DL8000 itself.)	
	Flags Immediately Set	None
	Flags Immediately Cleared	None
	Exceptions	None
	Supporting Parameters	Preset delivery type [63,0,29]
	Results	The response frame includes the values of following parameters: ▪ Number of meters [63,0,20] ▪ Meter Unauthorized Gross Total [75,x,5] ▪ Meter Unauthorized Net std or Mass Total [75,x,7 or 8] based on delivery type
	Deviations	None.

Request Meter Values [0x19]	Reads current values of various data for a given meter requested in the command request frame.	
	Flags Immediately Set	None
	Flags Immediately Cleared	None
	Exceptions	Invalid Meter Number
	Supporting Parameters	Preset delivery type [63,0,29]

Request Meter Values [0x19]

Results	The response frame includes the following parameter values for a given meter: ▪ Meter Gross Total [73,x,30] Non-resettable totals ▪ Meter Net std or Mass Total [73,x,34 or 36] Non-resettable totals based on delivery type. ▪ Meter Authorized Batch Gross Total [75,x,10] ▪ Meter Authorized Batch Net std or Mass Total [75,x,12 or 13] based on delivery type ▪ If using volumetric flow meter, DL8000 returns Gross volume flowrate [73,0,29]; if using mass flow meter, DL8000 returns mass flowrate [73,x,35]. ▪ Current Meter factor [73,x,15] ▪ Current pulse count reading from pulse input configured [73,x,20] ▪ Number of factors or flow rate [63,0,109] ▪ Meter Un-authorized Batch Gross Total [75,x,48] ▪ Meter Un-authorized Batch Net std or Mass Total [75,x,49 or 50] based on delivery type ▪ Meter Authorized Net std or Mass Total [75,x,17 or 18] based on delivery type ▪ Current Temperature [73,x,25] ▪ Current Density [73,x,18] ▪ Current Pressure [73,x,24]
Deviations	The DanLoad 6000 preset returned the following values. However, they are not available in the DL8000 and are always zeroed out: ▪ Average flow rate over 1 sec ▪ Average Batch flow rate ▪ Max average over 1 sec flow rate ▪ Number of pulses received at different flow rate set points ▪ Pulse count is a 4-byte value in DL8000 and a 2-byte value in DanLoad 6000. For this reason, value may not be accurate beyond 65535.

Request Component Value [0x1A]

Reads current values of various data for a given component requested in the command request frame.

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	Invalid component number
Supporting Parameters	Preset delivery type [63,0,29]

Request Component Value [0x1A]

Results	The response frame includes the values of following parameters for a given component: ▪ Component Gross Total [69,x,30] ▪ Component Net std or Mass Total [69,x,32 or 33] based on delivery type ▪ Component Batch Gross Total [69,x,25] ▪ Component Batch Net std or Mass Total [69,x,27 or 28] based on delivery type ▪ Component Avg (FWA) Batch Temperature [69,x,61] ▪ Component Avg (FWA) Batch Density [69,x,100] ▪ Component Avg (FWA) Batch Pressure [69,x,72] ▪ Average of last five valve closure pulses [69,x,13;14;15;16;17] ▪ Actual component % in batch [69,x,59]
Deviations	None

Request Power Fail Date and Time [0x1B]

Reads date and time at which DL8000 last lost its power. This value stores in the system parameters [91,0,47].

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	None
Supporting Parameters	None
Results	None
Deviations	None

Display Message [0x1C]

Displays to the DL8000 operator either an informational message or a prompt message designed to get some input data.

The DL8000 prompts the operator with display data message text received in the command request frame [63,0,175] to enter/request data before authorizing a new batch. It clears data item [63,0,177].

The prompt field width received in the command request frame is limited between 0 to 8. If its value is less than 0, then 0 is assumed; if its value is more than 8, then 8 is assumed.

If the prompt field width is **zero** then it acts as a pure informational message command. If the prompt field width is **non-zero** then the operator can use the rest of the number of characters for the data. Pressing the Clear key clears the input field and restarts input entry. Pressing the Enter key terminates input entry. If an operator presses Enter when the input field is blank, the keypad data available to the automation system a value of 0.

If the timeout time received in the command request frame is less than 0, then the DL8000 uses the configured timeout time [63,0,171]. If timeout is set as zero then a timeout never occurs (that is, a message or prompt displays until the DL8000 receives a Timeout Operation command [0x05]). If timeout value received is greater than 0, then use received timeout value.

Valid input control values are:

0 = Display Numeric keys on display

1 = Display an asterisk (*) for each numeric key pressed

Flags Immediately Set	K&D Locked Out
Flags Immediately Cleared	▪ Operation Timed Out ▪ Keypad Data Available
Exceptions	▪ Passcode Entry in Progress ▪ Batch in Progress ▪ Primary Alarm ▪ Operating Mode is Manual ▪ K&D Locked Out
Supporting Parameters	▪ Prompt width [63,0,176] ▪ Timeout time [63,0,171] ▪ Display message input control [63,0,253]
Results	The operator has to enter auxiliary data item within configured timeout time [63,0,171]; otherwise, the operation aborts and sets the Operation Timed Out flag (bit 3 in [63,0,119]). If a timeout occurs, the DL8000 displays a "Timeout Operation" message and waits for the next TAS command. Once the operator enters auxiliary data item, the DL8000 clears the Operation Timed Out and K&D Locked Out flags. It also sets the Keypad Data Available flag, which tells the TAS that the operator has entered data. The DL8000 displays a “Data Entered” message and waits for the next TAS command.

Display Message [0x1C]	**Deviations**	▪ The DanLoad 6000 has capacity to display a 128-character long text message. The DL8000 supports the first 20 characters of text message received. ▪ In the DanLoad 6000, if prompt field width is greater than 0, the timeout timer is started again whenever a key is pressed. If prompt field width is zero, a timeout occurs after the specified timeout time. In the DL8000, the prompt field width does not affect the timeout time.

Request Keypad Data [0x1D]	Retrieves input requested via Display Message command [0x1C]. When keypad input is terminated, the DL8000 sets a flag to indicate that the keypad data is available.	
	Flags Immediately Set	None
	Flags Immediately Cleared	None
	Exceptions	▪ Batch in progress ▪ Primary alarm active ▪ No keypad data available ▪ Operating mode is manual
	Supporting Parameters	None
	Results	Value stored at [63,0,177] is returned in response.
	Deviations	None

Request Transaction Storage Status [0x1E]

Retrieves the transaction and batch storage status. It can be issued at anytime.

The transaction or batch sequence number is a unique four-digit number (from 0 to 9999) the system assigns to transactions or batches. You cannot reset the sequence number. The system stores fewer than 10,000 transactions or batches, depending on the configuration. Transaction or batch numbers roll from 9999 to 0.

The system computes the sequence number for the newest **transaction** stored as:

(Oldest Transaction sequence number + Number of Transactions stored – 1) % 10000

The system computes the sequence number of the newest **batch** stored as:

(Oldest Batch sequence number + Number of Batches stored – 1) % 10000

where **%** is the C language modulus operator.

On warm up booting, the DL8000 calculates the current transaction and batch record lengths. If the current transaction record length does not equal the stored transaction record length [61,0,120], the system raises a transaction configuration error [61,0,133]. If the current batch record length does not equal the stored batch record length [61,0,126], the system raises a batch configuration error [61,0,134].

If a transaction is not authorized, then a user program enables you to change configuration. If you change any history configuration related to archiving transaction, then the system sets a transaction configuration error [61,0,133]. If the configuration change is related to the batch, then the system sets a batch configuration error [61,0,134].

If you change the configuration for Storage Memory Full Alarm Configuration [61,0,130], Archive Batches Per Transaction [61,0,145], or Requested Max Transactions [61,0,146], the system does not set a transaction or batch history error, since those changes do not impact memory structure or history.

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	Transaction history module is not running in the DL8000.
Supporting Parameters	None

Request Transaction Storage Status [0x1E]

Results	The command response frame consists of the following parameter values: ▪ Oldest Transaction sequence number stored [61,0,123] ▪ Number of Transactions stored [61,0,122] ▪ Maximum number of transactions that can be stored [61,0,121] ▪ Transaction Configuration Error [61,0,133] ▪ Oldest Batch sequence number stored [61,0,129] ▪ Number of Batches stored [61,0,128] ▪ Maximum number of batch that can be stored [61,0,127] ▪ Batch Configuration Error [61,0,134]
Deviations	None

Transaction Data by Component [0x1F]

Requests data for the transaction after the current transaction has ended. The DL8000 sets a flag indicating that the transaction has ended. In manual operating mode, press **Stop** to end a transaction when there is a transaction in progress and no batch in progress. In automatic operating mode, you end a transaction using the End Transaction command [0x07].

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	▪ No Transaction ended ▪ Invalid transaction sequence number
Supporting Parameters	Preset delivery type [63,0,29]

Transaction Data by Component [0x1F]

Results	The command response frame consists of the following parameter values: ▪ Transaction sequence number [61,0,124] same as that received in command request frame ▪ Recipe number [63,0,118] ▪ Current swing arm side [63,0,145] (applicable valid only for Version 2.0 and later) ▪ Transaction gross volume [63,0,140] or Composite Transaction gross volume [64,0,3] based on Preset Additive option [64,0,26] is set as “Exclusive” or “Inclusive” respectively. **Note**: Composite Transaction available only in version 2.0 and later) ▪ Transaction net-std volume or mass [63,0,142 or 143] based on delivery type ▪ Transaction start date and time [63,0,230] ▪ Transaction end date and time [63,0,231] ▪ Number of meters [63,0,20] ▪ Number of data prompts [63,0,186] ▪ Meter Gross Transaction start total snapshot [75,x,34] ▪ Meter Net std or Mass Transaction start total snapshot [75,x,35 or 36] based on delivery type ▪ Meter Gross Transaction end total snapshot [75,x,37] ▪ Meter Net std or Mass Transaction end total snapshot [75,x,38 or 39] based on delivery type ▪ Data items entered [63,0,188;190;192;194;196] by operator in manual or downloaded by automation system in automatic
Deviations	▪ Preset Additive option [64,0,26] is additional feature not available in DanLoad 6000 protocol (applicable for Version 2.0 and later). ▪ Swing arm side is not supported in DL8000, so its value returned in the command response frame is always 1 (applicable **only** for Version 1).

Initialize Transaction Storage [0x20]

Clears all stored transaction history records and initializes them at zero.

Flags Immediately Set	None
Flags Immediately Cleared	None

Initialize Transaction Storage [0x20]

Exceptions	▪ Transaction in Progress ▪ Transaction history module is not running in preset
Supporting Parameters	None
Results	Transaction storage initialization may take several seconds to complete. This command does not modify the rolling four-digit transaction and batch sequence numbers.
Deviations	None

Start Communication [0x21]

Initiates communication between the TAS and the DL8000. When the DL8000 has experienced:

- Powered-up/reset
- Program mode exit
- Communication failure alarm reset.

The TAS can start or initiate communication with the DL8000 using this command. If communications are already started when this command is received, then the communication link is re-initialized but operations at the DL8000 are unaffected. The command resets the alternating function code sequence, using function codes 41h or 42h for the query. The next (non-retry) query from the TAS should use the other function code (that is, if 41h initiates the query, 42h should be the next non-retry query).

Under the DanLoad 6000 protocol, until communications are established using this command, the DL8000 accepts no other command.

Operation of DL8000 remains unaffected by Start Communication command.

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	None
Supporting Parameters	None
Results	The command response frame consists of the following parameters: ▪ Number of meters [63,0,20] ▪ Number of components [63,0,21] ▪ Number of valves [63,0,19] ▪ Number of factors or flow rate [63,0,109] ▪ Number of recipes [63,0,26] ▪ Number of additives [63,0,100] ▪ Temperature Units Option [70,0,2] ▪ Temperature correction option [71,x,28] ▪ Pressure correction option [71,x,29]

Start Communication [0x21]

Deviations	▪ The Temperature correction option [71x,28] values the DL8000 returns do not map directly to the DanLoad 6000 program codes (432, 435, etc.) for all values. ▪ The Pressure correction option [71,x,29] values the DL8000 returns do not map directly to the DanLoad 6000 program codes (444, 447, etc.) for all values.

Request Program Code Values and Attributes [0x22]

A program code value is a number. A program code identifies a variable (parameter) in DanLoad 6000. This parameter is mapped to DL8000. A program code value is the value of variable identified by the program code and can be a number of byte length depending on the program code. A program code's attributes are the properties associated with that program code. Since TAS can request a range of program code values (from those which are supported) and attributes the response data field is variable field length.

The following program codes (with their data types) are supported for this release:

- 026 Unit Type (16-bit integer)
- 028 Language (8- bit integer)
- 042 Last Transaction Number(16-bit integer)
- 043 Last Batch No(16-bit integer)
- 044 Additive Unit(16-bit integer)
- 046 Density/Gravity Scale (8- bit integer)
- 067/070/073/076 Component 1 to 4 Meter Nos.(16-bit integer)
- 457/459/461/463 Backup density(32-bit integer)

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	▪ 03h Response's data field too long ▪ 44h Invalid program code number
Supporting Parameters	▪ Unit Type [63,0,12] ▪ Language [63,0,14] ▪ Last Transaction Number [63,0,124] ▪ Last Batch No [63,0,125] ▪ Additive Unit [63,0,101] ▪ Density/Gravity Scale [63,0,151] ▪ Component 1 to 4 Meter Nos [69,X,7] ▪ Backup density [72, X, 8]

Request Program Code Values and Attributes [0x22]

Results	The DL8000 should respond with the value and attributes of the requested program codes (the ones which are supported). Some parameters are returned after scaling. The scale can be a fixed multiplication factor or may depend on some other configurable parameter. Scaled parameters are : ▪ 457/459/461/463 Backup density – scaling multiplication factor = 10 ^ (PC046 Density/Gravity Scale)
Deviations	The program code attribute byte contains only the following flags: ▪ 00 - No attribute set. ▪ 01 - Read only. ▪ 02 - Weights and Measures. The other flags are not supported.

Set Program Code Value [0x23]

Use this to configure the DL8000 from a TAS. The DL8000 validates the program code value being sent and responds with exception code 45h if it is not valid.

The following program codes (with their data types) have been supported for this release:

- 026 Unit Type (16-bit integer)
- 028 Language (8- bit integer)
- 044 Additive Unit(16-bit integer)
- 046 Density/Gravity Scale (8- bit integer)
- 067/070/073/076 Component 1 to 4 Meter Nos.(16-bit integer)
- 457/459/461/463 Backup density(32-bit integer)

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	▪ 04h Program code value is Weights and Measures. ▪ 09h Transaction in progress ▪ 0Ah Primary alarm active ▪ 11h Program code value is read only ▪ 15h Operating mode is manual ▪ 44h Invalid program code ▪ 45h Invalid program code value
Supporting Parameters	▪ Unit Type [63, 0, 12] ▪ Language [63, 0, 14] ▪ Additive Unit [63, 0, 101] ▪ Density/Gravity Scale [63, 0, 151] ▪ Component 1 to 4 Meter Nos [69, X, 7] ▪ Backup density [72, X, 8]

Set Program Code Values [0x23]

Results	Some parameters are set after scaling. The scale can be a fixed multiplication factor or may depend on some other configurable parameter. The scaled parameters are : ▪ 457/459/461/463 Backup density – scaling multiplication factor = 1 / (10 ^ (PC046 Density/Gravity Scale)
Deviations	Transaction authorized exception is checked in place of Transaction in progress

Configure Recipe [0x27]

Use this command when configuring specific recipes.

Inline blending has special considerations. Set the low/high proportion flags carefully; it is possible that a particular component is high proportion (flag=0) for some recipes and low proportion (flag=1) for different recipes on the same DL8000. This is a function of the size of meter (and thus the usable range of flow rates) through which the component flows. You may need to modify the overall recipe low and high flow rates [68,x,23 and 24] if you modify component percentages through communications.

This command does not automatically increase or decrease the configured number of recipes [63,0,26].

Flags Immediately Set	Program Code Value Changed
Flags Immediately Cleared	None
Exceptions	▪ Primary alarm active ▪ Transaction authorized ▪ Operating mode is manual ▪ Invalid recipe number ▪ Invalid Number of components (if number of components received in command request frame is not the same as the configured number of components) ▪ Invalid Program Code Value (if component percentage received is more than 100 or any character received in delivery sequence is non-numeric or is more than ASCII equivalent of configured number of components)
Supporting Parameters	▪ Recipe name [68,x,0] ▪ Percentage of component 1 [68,x,1] ▪ Percentage of component 2 [68,x,2] ▪ Percentage of component 3 [68,x,3] ▪ Percentage of component 4 [68,x,4] ▪ Component Delivery Sequence or low/high proportion [68,x,17] ▪ Number of components [63,0,21]
Results	If no exceptions are raised then parameters received for the recipe get written to the above locations.
Deviations	Supports additional exception such as Invalid program code value

Get Date and Time [0x28]

The DL8000 has a battery-backed real-time clock which maintains the date and time even when the unit is powered down.

This command retrieves the year, month, day, hours, minutes and seconds from its battery backed real-time clock from Point Type 136: ROC Clock.

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	None
Supporting Parameters	None
Results	None
Deviations	None

Set Date and Time [0x29]

Validates the date and time received in the command request frame the TAS issues. If both the date and time are valid, the DL8000 sets its battery-backed real-time clock in point type 136 (ROC Clock).

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	▪ Transaction is authorized ▪ Invalid time ▪ Invalid date
Supporting Parameters	Point Type 136: ROC Clock
Results	As above
Deviations	None

Request Firmware Version [0x2A]

Provides the version number of the DL8000 firmware and the LiquidCalcs and Batching user programs. When the DL8000 receives this command, it responds with three null-terminated string in the format:

DL8000 VerX.XX
LiquidCalcs VerY.YYY
Batching VerX.XXX.

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	None
Supporting Parameters	▪ Part Number and Version [91,0,3] ▪ Program Version String [94,x,1]
Results	As above

Request Firmware Version [0x2A]	**Deviations**	The format and length of the version number for the DanLoad 6000 and DL8000 are different. The DanLoad 6000 preset had two CPUs and responded with the firmware version of each CPU. The DL8000 has only one CPU, and responds with the version number of the user programs.

Reset Unit [0x30]	Initiates a warm restart of the DL8000 (similar to a power-up), and restarts all user program. This command cannot be issued when a transaction is in progress.	
	Flags Immediately Set	None
	Flags Immediately Cleared	None
	Exceptions	▪ Transaction in progress ▪ Weights and Measure locked
	Supporting Parameters	None
	Results	As above
	Deviations	Supports additional exceptions such as Weights and Measure locked

Last Key Pressed [0x31]	Responds with key code of keypad key most recently pressed. The Key Pressed [0x0B] status flag (in the response of commands Request Status [0x12] and Enhanced Request Status [0x3C]) indicates if a key code is available. The TAS can clear the Key Pressed status flag using the Clear Status [0x13] command if a “new” key code is required.	
	Flags Immediately Set	None
	Flags Immediately Cleared	None
	Exceptions	▪ No Key Pressed 1Ah
	Supporting Parameters	Last Key Pressed [62,0,149] is converted to DanLoad 6000-specific key code before returning in the response frame.
	Results	As above.
	Deviations	None

Swing Arm Side [0x33]	Returns current swing arm side. The DL8000 supports this command for both automatic and manual modes.	
	Flags Immediately Set	None
	Flags Immediately Cleared	None
	Exceptions	None
	Supporting Parameters	Swing Arm Current Side [63,0,145]
	Results	The DL8000 responds with the swing arm side (0, 1, or 2) as determined by the Swing Arm Current Side [63,0,145].

Swing Arm Side [0x33]

Deviations	▪ Swing arm features is not implemented in DL8000. Some TAS use current side, so DL8000 gives the value stored in [63,0,145] (applicable only for Version 1.0). ▪ None (applicable only for Version 2.0 and later).

Weights & Measures Switch [0x36]

Reports the current state (0=Open or 1=Closed) of the Weights & Measures switch from location [62,0,148]. You cannot modify any defined Weights & Measures parameters when the Weights & Measures switch is closed.

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	None
Supporting Parameters	None
Results	As above
Deviations	None

Change Operating Mode [0x37]

Allows the TAS to change the DL8000's operating mode with options (0=Auto, 1=Manual) as received in the command request frame. If the DL8000 is already in the desired mode then the command is simply acknowledged.

For **Version 1.0**: Mode does not change if batch halts at alarm halt.
For **Version 2.0**: In auto mode, if alarm raises then mode changes to manual and current batch completed before ending the transaction.

If transaction is authorized and this command is issued then the DL8000 ends the current transaction. The operating mode changes after the current transaction ends.

Flags Immediately Set	Operating Mode is Manual (when new mode is manual)
Flags Immediately Cleared	▪ Operating Mode is Manual (when new mode is auto) ▪ Operation Timed Out ▪ Recipe Selected ▪ Additive Selected ▪ Preset Volume Entered ▪ Keypad Data Available ▪ K&D Locked Out
Exceptions	▪ No batch stopped ▪ Batch is in progress and any non primary alarm with severity more than info (1) is active. ▪ Batch is in progress and any primary alarm is active. ▪ Invalid operating mode
Supporting Parameters	None

Change Operating Mode [0x37]	**Results**	The DL8000 changes the operating mode as requested and displays a new screen based on the new mode.
	Deviations	No batch stopped

Clear Display [0x38]	Clears the DL8000's multi line display. Use this command to erase recipe menu content after a prompt recipe command, additive menu content after a prompt additive command, loading screen content after an authorized transaction command, a prompt preset volume command or an authorize batch command.	
	Flags Immediately Set	None
	Flags Immediately Cleared	None
	Exceptions	▪ Passcode Entry in Progress ▪ Operating Mode is Manual ▪ K&D Locked Out
	Supporting Parameters	None
	Results	Clears existing screen and displays a "Please wait" message until the next TAS command. The alarm and date-time continue to display.
	Deviations	None

Request Stored Transaction [0x39]	Use this command to request the transaction record from the (transaction storage) transaction file. You can configure the format of the transaction record and the DL8000 only archives the configured parameters. Valid transaction sequence numbers are 0 through 9999.	
	Flags Immediately Set	None
	Flags Immediately Cleared	None
	Exceptions	▪ 1Dh Transaction not on file ▪ 03h Response Data Field Too Long (currently not generated)
	Supporting Parameters	None
	Results	The DL8000 customizes the response frame when returning the transaction record, as described in the Deviations section. Currently, the DL8000 does not raise the exception Response Data Field Too Long in this command. The maximum data length (when all transaction data is configured to be archived) is less than maximum data that can be sent through the response frame.

	Deviations	The command query frame has the following format:
		`struct Tasq`
		`{`
		`Unsigned char dfl; // datafield length`

```
Unsigned char cmdcode; // command code
Int trseq; // transaction sequence number
};
```

The command response frame differs from that of the DanLoad 6000 protocol:

```
struct Tasr
{
Unsigned char dfl; // datafield length
Unsigned char cmdcode; // command code
Unsigned long noOfBatches; // num of batches
Unsigned long seqNumOfFirstBatch; // Seq. num
of 1st batch in transactionUnsigned char
configstatus[6]; // configuration bytes 1 to 6
Unsigned long data1[copies1]; // data of
configured param no 1
Unsigned long data2[copies2]; // data of
configured param no 2
:
:
:
Unsigned long dataN[copiesN]; // data of
configured param no N
};
```

The first two data points in the response frame are those which are archived by default (namely, the number of batches and the sequence number of the first batch in the transaction).

The next 6 bytes (configstatus[6]) give the transaction record format in bit format. The bits starting from 0 to 7 through all the configstatus[] bytes 1 to 6 give the configuration in following order:

Byte 1 Bit 0 : Unit Address (archived by default)[61,0,21]
Byte 1 Bit 1: Recipe Num [61,0,22]
Byte 1 Bit 2: Data Item 1 [61,0,23]
Byte 1 Bit 3: Data Item 2 [61,0,24]
Byte 1 Bit 4: Data Item 3 [61,0,25]
Byte 1 Bit 5: Data Item 4 [61,0,26]
Byte 1 Bit 6: Data Item 5 [61,0,27]
Byte 1 Bit 7: Start Date Time [61,0,28]
Byte 2 Bit 0: End Date Time 61,0,29]
Byte 2 Bit 1: Trans Gross Qty [61,0,30]
Byte 2 Bit 2: Trans Std Qty [61,0,31]
Byte 2 Bit 3: Trans Weight Qty [61,0,32]
Byte 2 Bit 4: Trans Start Gross [61,0,33]
Byte 2 Bit 5: Trans Start Std [61,0,34]
Byte 2 Bit 6: Trans Start Weight [61,0,35]
Byte 2 Bit 7: Trans End Gross [61,0,36]
Byte 3 Bit 0: Trans End Std [61,0,37]
Byte 3 Bit 1: Trans End Weight [61,0,38]
Byte 3 Bit 2: Trans Add Gross [61,0,39]

If the bit for archive configuration parameter is 1, then the value of that parameter from the transaction record is included in the response frame. Each history data is returned as consecutive 4-bytes data. All the parameters of double data type in DL8000 will be returned as 4-bytes unsigned long and all others will be returned as 4-bytes float data.

Some of the transaction data is archived by default and not configurable. Refer to *Section C.2.5, Transaction History* in *Appendix C* of the *ROCLINK 800 Configuration Software User Manual (for DL8000)*, (Form A6240) for details.

The parameter values are returned in the same order in which the configuration bits are reported. All the copies archived for each configured archive parameter are returned in the response frame. The number of copies archived for each parameter is always fixed. For example, **4** for data referring to components, **4** for data referring to meters, and **6** for data referring to additives.

Example: If configstatus[6](hex) = 0D 90 00 00 00 00, then data following the configstatus[6] in the response frame is formatted as:

```
float Unit Address
float Data Item 1
float Data Item 2
float Trans Start Gross Meter 1
float Trans Start Gross Meter 2
float Trans Start Gross Meter 3
float Trans Start Gross Meter 4
float Trans End Gross Meter 1
float Trans End Gross Meter 2
float Trans End Gross Meter 3
float Trans End Gross Meter 4
```

Note: The DL8000 does not consider the multiplication factors used for returning some parameters in other DanLoad 6000 commands when returning the value (read from the archived data) in the response frame.

Request Stored Batch [0x3A]

Use this command to request the batch record from the (transaction storage) batch file. You can configure the format of the batch record; the DL8000 archives only the configured parameters. Valid batch sequence numbers are 0 through 9999.

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	▪ 1Eh Batch not on file ▪ 03h Response Data Field Too Long
Supporting Parameters	None
Results	The DL8000 customizes the response frame when returning the batch record, as described in the Deviation section.
Deviations	The command query frame has the following format:

```
struct Tasq
{
Unsigned char dfl; // datafield length
Unsigned char cmdcode; // command code
baseq; // batch sequence number
};
```

The command response frame differs from that of the DanLoad 6000 protocol:

```
struct Tasr
{
Unsigned char dfl // datafield length
Unsigned char cmdcode; // command code
Unsigned long transactionSeqNum; //
transaction sequence no. for this batch
Unsigned long configMode; // batch done in
configuration mode
Unsigned char configstatus[6]; //
configuration bytes 1 to 6
Unsigned long data1[copies1]; // data of
configured param no 1
Unsigned long data2[copies2]; // data of
configured param no 2
:
:
:
Unsigned long dataN[copiesN]; // data of
configured param no N
};
```

The first two data points in the response frame are those which are archived by default (namely, the transaction sequence no. for this batch and batch done in configuration mode).

The next 6 bytes (configstatus[6]) give the batch record format in bit format. The bits starting from 0 to 7 through all the configstatus[] bytes 1 to 6 give the configuration in following order:

Byte 1 Bit 0: Base Temp Option (archived by default) [61,0,5]

Byte 1 Bit 1: FWA Pressure [61,0,6]

Byte 1 Bit 2: FWA Base Density (archived by default) [61,0,7]

Byte 1 Bit 3: FWA Tempt (archived by default) [61,0,8]

Byte 1 Bit 4: Preset Qty [61,0,9]

Byte 1 Bit 5: Gross Qty (archived by default) [61,0,10]

Byte 1 Bit 6: Std Qty (archived by default) [61,0,11]

Byte 1 Bit 7: Weight [61,0,12]

Byte 2 Bit 0: Comp Gross Qty [61,0,13]

Byte 2 Bit 1: Comp Std Qty [61,0,14]

Byte 2 Bit 2: Comp Weight Qty [61,0,15]

Byte 2 Bit 3: Comp Temp [61,0,16]

Byte 2 Bit 4: Comp 1 Req Percentage [61,0,17]

Byte 2 Bit 5: Comp Batch Percentage [61,0,18]

Byte 2 Bit 6: Add Gross Qty [61,0,19]

Byte 2 Bit 7: Operating Mode [61,0,20]

Byte 3 Bit 0: Comp 2 Req Per [61,0,141]

Byte 3 Bit 1: Comp 3 Req Per [61,0,142]

Byte 3 Bit 2: Comp 4 Req Per [61,0,143]

Byte 3 Bit 3: Comp Pressure [61,0,152]

Byte 3 Bit 4: Comp Base Density [61,0,153]

Byte 3 Bit 5: Batch Start Indicated [61,0,195]

Byte 3 Bit 6: Batch End Indicated [61,0,196]

Byte 3 Bit 7: Average component k-factor [61,0,205]

Byte 4 Bit 0: Average component meter factor (FWA) [61,0,206]

Byte 4 Bit 1: Average component CTL (FWA) [61,0,215]

Byte 4 Bit 2: Average component CPL (FWA) [61,0,216]

Byte 4 Bit 3: Comp Observed density [61,0,225]

Byte 4 Bit 4: Density Units (archived by default) [61,0,249]

If the bit for archive configuration parameter is 1, then the value of that parameter from the batch record is included in the response frame. Each history data is returned as consecutive 4-bytes data. All the parameters of double data type in DL8000 are returned as 4-bytes unsigned long and all others will be returned as 4-bytes float data.

Some of the batch data is archived by default and not configurable. Refer to *Section C.2.5, Transaction History* in *Appendix C* in the *ROCLINK 800 Configuration Software User Manual (for DL8000)*, (Form A6240) for details.

The parameter values are returned in the same order in which the configuration bits are reported. All the copies archived for each configured archive parameter are returned in the response frame. The number of copies archived for each parameter is always fixed. For example, **4** for data referring to components, **4** for data referring to meters, and **6** for data referring to additives.

Example: If configstatus[6](hex) = 7D 01 00 10 00 00, then data following the configstatus[6] in the response frame has the format:

```
float Base Temp Option
float FWA Base Density
float FWA Temp
float Batch Preset Qty
unsigned long Batch Gross Qty
unsigned long Batch Std Qty
unsigned long Gross Qty Comp 1
unsigned long Gross Qty Comp 2
unsigned long Gross Qty Comp 3
unsigned long Gross Qty Comp 4
float Density Units
```

Note: The DL8000 does not consider the multiplication factors used for returning some parameters in other DanLoad 6000 commands when returning the value (read from the archived data) in the response

frame.

Enhanced Start Communications [0x3B]

This command is an alternative to the Start Communications command [0x21], with the following **advantages**:

- It has a fixed length response.
- Its response contains all values necessary to predict the lengths of all other responses from the DL8000 unit.
- Its response informs the TAS of the configured language.

The TAS uses this command to initiate or start communication with the DL8000. When the DL8000 has experienced:

- Powered-up/reset
- Program mode exit
- Communication failure alarm reset.

the TAS can start or initiate communication with the DL8000 using this command. If communications are already started when this command is received, then the communication link is re-initialized but operations at the DL8000 are unaffected. The command resets the alternating function code sequence, using function codes 41h or 42h for the query. The next (non-retry) query from the TAS should use the other function code (that is, if 41h initiates the query, 42h should be the next non-retry query).

The query is 6 characters long: address (1 character), function code (1 character), data field length (1 character), command code (1 character) and checksum (2 characters). A valid example Enhanced Start Communications command for a DL8000 at communication address 01h would be (in hexadecimal):

01 41 02 3B 11 7F and 01 42 02 3B E1 7F

Under the DanLoad 6000 protocol, until communications are established using this command, the DL8000 accepts no other command.

The TAS can use this language to select an appropriate “message file” for sending text to the DL8000.

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	None
Supporting Parameters	None

Enhanced Start Communications [0x3B]

Results	The command response frame consists of the following parameters: ▪ Number of meters [63,0,20] ▪ Number of components [63,0,21] ▪ Number of valves [63,0,19] ▪ Number of factors or flow rate [63,0,109] ▪ Number of recipes [63,0,26] ▪ Number of additives [63,0,100] ▪ Temperature Units Option [70,0,2] ▪ Temperature correction option [71,x,28] ▪ Pressure correction option [71,x,29] ▪ Number of data items [63,0,186] ▪ Language used [63,0,14]
Deviations	▪ The Temperature correction option [71,x,28] values the DL8000 returns do not directly map to the DanLoad 6000 program codes 432, 435, etc. for all values. ▪ The Pressure correction option [71,x,29] values the DL8000 returns do not directly map to the DanLoad 6000 program codes 444, 447, etc. for all values. ▪ Swing arm side is not supported on DL8000, so its value returned in the command response frame is always **1** (applicable only for Version 1.0).

Enhanced Request Status [0x3C]

This command can be issued at any time to know the overall status of DL8000 unit. This command is an alternative to Request Status command [0x12].

This command has the following **advantages** over the Request Status [0x12] command:

- Its response contains the recipe number, additive selection, and preset volume. The Request Selected Recipe [0x02], Request Selected Additives [0x04], and Request Preset Volume [0x09] commands may no longer be required; the relevant data are available to the TAS immediately when the corresponding status bits change. Response times are improved.
- Its response contains the transaction storage status. The Request Transaction storage status command [0x1E] may no longer be required. This is particularly useful for “ticket printing” systems that upload batch and transaction data by watching for new records being written into the files.

This command has the following **disadvantages** over the Request Status [0x12] command:

- Its response time is slightly slower, but not significantly slower.
- Since there are no exceptions, it does not protect the TAS from making mistakes (such as using a recipe number when no recipe is selected and no transaction is authorized).

For the command response, see Results section below.

Status flags is a binary representation of the DL8000’s 32 status flags.

Safety circuit status is the current logical state (“open” or “closed”) of 8 general purpose safety circuit inputs. The least significant bit is safety circuit 1 etc. If you do not configure safety circuit input, then the value of bit for respective safety circuit will be equal to unsafe state [0].

Alarm bitmaps indicate active (raised and reset) alarms. The automation system can maintain a copy of the “alarm bytes” so that it can determine (for logging purposes) when alarms are raised or cleared.

The recipe number is valid while the recipe selected or the transaction authorized bits are set. (The recipe number authorized for the transaction need not be the same as the recipe number selected by the operator)

The additives selection bitmap is valid while the additives selected status bit is set.

The preset volume entered is valid while the preset volume entered or batch authorized status bits are set. For the former, it is the preset volume entered by the operator. For the latter, it is the preset volume authorized for the batch. (The preset volume authorized for the batch need not be the same as the preset volume entered by the operator).

Flags Immediately Set	None
Flags Immediately Cleared	None
Exceptions	None
Supporting Parameters	As above

Enhanced Request Status [0x3C]

Results

The response frame includes the values of following parameters:

- Status flags [63,0,119]
- Current swing arm side [63,0,145] (applicable only in Version 2.0 and later)
- Batch gross volume [63,0,135] or Composite Batch gross volume [64,0,2] based on Preset Additive option [64,0,26] is set as “Exclusive” or “Inclusive” respectively.

  Note: Composite Batch Gross Volume available in Version 2.0 and later.
- Batch net-std or Batch mass [63,0,137 or 138] based on delivery type
- Status of safety circuit inputs [63,0,98]

  Note: If you do not configure a safety circuit, the status of that circuit becomes 0.
- Alarm ID of oldest highest priority active alarm [63,0,111] – returned alarm code is in terms of DanLoad 6000. Value stored at this parameter is alarm code used by DL8000 which may not match with alarm code of DanLoad 6000.
- Alarm bitmaps of ten bytes (returned in terms of DanLoad 6000 alarm bytes)
- Recipe number selected [63,0,118]
- Additives selection bitmap [63,0,112]
- Preset volume entered [63,0,39]
- Oldest Transaction sequence number stored [61,0,123]
- Number of Transactions stored [61,0,122]
- Maximum number of transactions that can be stored [61,0,121]
- Transaction Configuration Error [61,0,133]
- Oldest Batch sequence number stored [61,0,129]
- Number of Batches stored [61,0,128]
- Maximum number of batch that can be stored [61,0,127]
- Batch Configuration Error [61,0,134]

Deviations

- In the DanLoad 6000 and other commands the DL8000 supports via the DanLoad 6000 protocol, the totalizers return mass totals if delivery type is mass. Otherwise the totals are net standard volumes.
- For the DanLoad 6000, alarm bitmaps of ten bytes retuned contains only the status of primary alarms. However, DL8000 returns the status of active alarms irrespective of alarm severity.
- The DanLoad 6000 protocol can be used only on a single port and only on Comm A.
- Preset Additive option [64,0,26] is additional feature not available in DanLoad 6000 protocol (applicable only in Version 2.0 and later).

Report Alarm [0x3D]

Raises an alarm based on alarm code received in the command request frame. Possible uses of this command are:

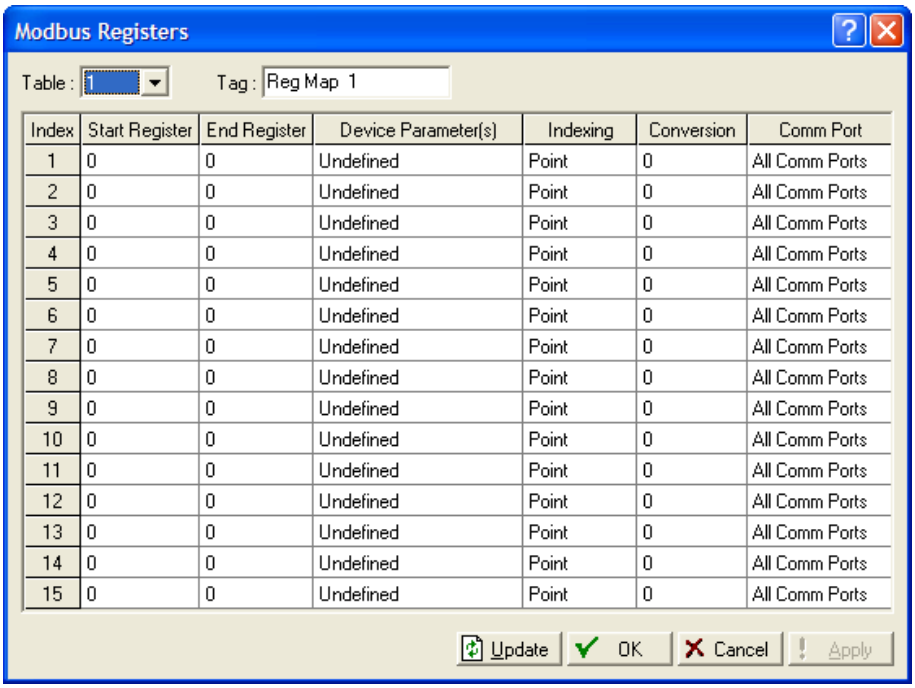
- Raising an alarm based on conditions that are either not input to or detectable by DL8000 (such as a fire detection system or a PLC being used to monitor a rail car's position).
- Stopping a batch with a situation-specific message. In this case, the automation system might configure a safety circuit alarm message via communications and then raise the corresponding safety circuit alarm. The automation system can reset the alarm using the Reset primary alarms command [0x14].

Note: A TAS should not depend on DL8000 alarms to prevent or control hazardous or life threatening conditions.

Flags Immediately Set	Primary Alarm active (if primary alarm is raised)
Flags Immediately Cleared	None
Exceptions	▪ Invalid bit no. (that is, the alarm code in the command request frame is invalid) ▪ Unable to set or reset alarm
Supporting Parameters	Alarm ID [63,0,173]
Results	Batch may stop due to reported alarm.
Deviations	▪ Comm B is not supported. ▪ Supports additional exception code "Unable to set or reset alarm" ▪ Does not support the following DanLoad 6000 protocol alarms: • Data logging memory full • Memory Check Failure • Primary Display Failure • Secondary Display Failure • MPMC 1 and MPMC 2 Failure • Calibration Failure for all meters • Intermediate Level Input

D.4 Mapping Modbus Registers

ROCLINK 800 provides Modbus register tables you use to map Modbus registers to TLP (Point Type, Logical, and Parameter) numbers in the DL8000. To access these tables, select **Configure** > **Modbus** > **Registers** from the ROCKLINK 800 menu bar. The Modbus Registers screen displays.



Index	Start Register	End Register	Device Parameter(s)	Indexing	Conversion	Comm Port
1	0	0	Undefined	Point	0	All Comm Ports
2	0	0	Undefined	Point	0	All Comm Ports
3	0	0	Undefined	Point	0	All Comm Ports
4	0	0	Undefined	Point	0	All Comm Ports
5	0	0	Undefined	Point	0	All Comm Ports
6	0	0	Undefined	Point	0	All Comm Ports
7	0	0	Undefined	Point	0	All Comm Ports
8	0	0	Undefined	Point	0	All Comm Ports
9	0	0	Undefined	Point	0	All Comm Ports
10	0	0	Undefined	Point	0	All Comm Ports
11	0	0	Undefined	Point	0	All Comm Ports
12	0	0	Undefined	Point	0	All Comm Ports
13	0	0	Undefined	Point	0	All Comm Ports
14	0	0	Undefined	Point	0	All Comm Ports
15	0	0	Undefined	Point	0	All Comm Ports

Figure D-1. Modbus Registers

Note that you have up to 15 entries per table, and up to 24 available register tables.

You can map one line on the Modbus Registers screen to more than one register to a TLP pair using either point indexing or parameter indexing:

- **Point Indexing** maps the Start Register to the selected TLP. You map subsequent registers (through the End Register) to the same point type and parameter and increment the **point logical** number.
- **Parameter Indexing** also maps the Start Register to the selected TLP. You map subsequent registers (through the End Register) to the same point type and point logical number, but increment the **parameter** number.

For example, with **Point Indexing** the configuration of:

Starting Register	Ending Register	Device Parameter(s)	Indexing	Conversion
100	103	AIN, 4-1, EU	Point	0

specifies four registers (100, 101, 102, and 103) that are mapped to a group of analog input (AIN) values in engineering units (EU) starting at the analog input in the fourth module location, first position (4-1), such that:

- Register 100 = EU of AIN point in location 4-1.
- Register 101 = EU of AIN point in location 4-2.
- Register 102 = EU of AIN point in location 4-3.
- Register 103 = EU of AIN point in location 4-4.

With **Parameter Indexing** the configuration of:

Starting Register	Ending Register	Device Parameter(s)	Indexing	Conversion
109	114	FST 1,R1	Parameter	1

specifies six registers (109, 110, 111, 112, 113, and 114) that are mapped to a group of FST 1 parameters starting at FST Register 1, such that:

- Modbus Register 109 = Register 1 of FST Point Number 1.
- Modbus Register 110 = Register 2 of FST Point Number 1.
- Modbus Register 111 = Register 3 of FST Point Number 1.
- Modbus Register 112 = Register 4 of FST Point Number 1.
- Modbus Register 113 = Register 5 of FST Point Number 1.
- Modbus Register 114 = Register 6 of FST Point Number 1.

Conversion Code 1 (Float to Integer, Float Scale 1) converts the floating point value to an integer before the response message returns to the host. Once you map a register, any Modbus request can reference it, providing the TLP's data type is appropriate for the function code.

Note: If the native data type does not meet the requirements of the Modbus Host device, conversion codes are available to convert the data to the required data type. For the **DL8000**, you can select to have the mapping apply to all communication ports or on a selected port only.

When the system receives a Modbus request, it searches for the referenced register(s). If it finds a matching register number, the system builds a response based on the device point type and parameter configured in the table. If the system cannot find a register number match, it returns an error message.

A DL8000 has 24 available register tables, each table containing 15 entries.

You use either point indexing or parameter indexing to define multiple registers for each table entry. By making the registers continuous (where the Start Register address of a new line is one greater than the End Register address of the previous line), you can create a continuous data

table for Modbus Function 3, 4, or 16 up to the limit of 240 bytes. This type of data table allows access to all its data with one request.

Periodic (Hourly) or Daily History Index registers should be mapped to the TLP for the Periodic Index (Point Type 124, Parameter 5) or Daily Index (Point Type 124, Parameter 6). In this TLP, the Logical number is the History Segment number. Remember to create an index for each History Segment from which you need to request history.

For Function Codes 01, 02, 05, and 15, the parameter specified should be a single-byte parameter type, preferably a status parameter (only bit 0 is used), because this function packs the data into a binary format for transmission. Each address span must be unique within the function for proper operation. If not, the first valid address is used.

D.5 DanLoad 6000 Protocol Frame

The DanLoad 6000 protocol supports a maximum of 256 bytes in one Request/Response frame. Numeric data is transmitted in binary with LSB byte first and MSB byte last.

Frame queries, responses, and exception responses using the following format:

ADR	FN	D1	D2	Dn	BCC1	BCC2

Frame format for Normal Query and Response

ADR	Address Field: 01h to FFh for individual module. Address = **00h** indicates Broadcast Request; means Only Process this Query But need not to reply back.
FN	Function Fields: 41h or 42h
D1	Data Field character 1 indicates length of data field. Data Field Length does not include device address, function code, or CRC bytes
D2	Data field character 2 indicates Command code
D3	Any data. **Note**: String data remains Null Terminated in any Query/Response.
Dn	Data field character n
BCC1	Block check character 1 is Error check field (CRC-16) character 1.
BCC2	Block check character 2 is Error check field (CRC-16) character 2.

Frame format for Exception Response

ADR	Address Field: 01h to FFh for individual module.
FN	Exception Response C1h and C2h for function codes 41h and 42h respectively.
D1	Data Field character 1 indicates length of data remains 3 which includes D1, D2 and D3. Data Field Length does not Include Device address, Function code and CRC bytes
D2	Data field character 2 indicates Command code
D3	Exception code
BCC1	Block check character 1 is Error check field (CRC-16) character 1.
BCC2	Block check character 2 is Error check field (CRC-16) character 2.

D.6 BCC Calculation

The destination station uses block check characters (BCCs) to verify the accuracy of received data. The transmitting station calculates the BCC for each message and transmits them. The receiving station then calculates the BCC for each message it receives and then compares the calculated BCCs to the received BCCs. A difference between two BCCs indicates a data error and so that do not reply. While responding to messages it is a good practice to calculate the BCC first and then make frame and reply back to the TAS.

Following is an example of the steps involved in calculating the CRC-16 using C language. Below is the CRC-16 calculation steps using C language. Consider following sequence for CRC-16. CRC-16 Checksum Table is given below.

Data Sequence: 01 41 02 21 (consisting of address byte, function code and data fields)

1. Take two variables each of two-bytes size:
   crcResult = FFFFh and tempVar = FFFFh.
2. Take another one byte variable dataByte = 01h (first byte of frame)
3. Repeat following steps for each data byte (dataByte) in the frame up to last byte in frame
   a. crcResult = crcResult << 8 (left shift by 8) –
      Result = FFFF SHL 8 = FF00
   b. tempVar = tempVar >> 8 (right shift by 8) –
      Result = FFFF SHR 8 = 00FF
   c. tempVar = tempVar ^ dataByte (EXOR operation) – dataByte =01
      Result = 00FF XOR 01 = 00FE
   d. tempVar = crc16Table [tempVar] (Get value from CRC-16 table shown below using tempVar as an index)
      Result = crc16Table [00FE] = 8180
   e. Get final CRC-16 answer of first byte by crcResult = crcResult ^ tempVar (EXOR operation)
      Result = FF00 XOR 8180 = 7E80
   f. Assign value of first CRC-16 to crcResult and tempVar
4. Finally after calculating CRC using last data byte of the frame the result comes to be 90B4. This CRC-16 checksum should be transmitted upper byte first (BCC1 = 90h) and lower byte second (BCC2 = B4h), The complete message with CRC-16 checksum is: 01 41 02 21 90 B4

D.7 CRC-16 Checksum Table

Use the following database to calculate CRC-16 values for the DanLoad 6000 protocol frame.

Table D-3. CRC-16 Checksum

Const unsigned short crc16Table[256] =

{ 0x0000, 0xc1c0, 0x81c1, 0x4001, 0x01c3, 0xc003, 0x8002, 0x41c2,
0x01c6, 0xc006, 0x8007, 0x41c7, 0x0005, 0xc1c5, 0x81c4, 0x4004,
0x01cc, 0xc00c, 0x800d, 0x41cd, 0x000f, 0xc1cf, 0x81ce, 0x400e,
0x000a, 0xc1ca, 0x81cb, 0x400b, 0x01c9, 0xc009, 0x8008, 0x41c8,
0x01d8, 0xc018, 0x8019, 0x41d9, 0x001b, 0xc1db, 0x81da, 0x401a,
0x001e, 0xc1de, 0x81df, 0x401f, 0x01dd, 0xc01d, 0x801c, 0x41dc,
0x0014, 0xc1d4, 0x81d5, 0x4015, 0x01d7, 0xc017, 0x8016, 0x41d6,
0x01d2, 0xc012, 0x8013, 0x41d3, 0x0011, 0xc1d1, 0x81d0, 0x4010,
0x01f0, 0xc030, 0x8031, 0x41f1, 0x0033, 0xc1f3, 0x81f2, 0x4032,
0x0036, 0xc1f6, 0x81f7, 0x4037, 0x01f5, 0xc035, 0x8034, 0x41f4,
0x003c, 0xc1fc, 0x81fd, 0x403d, 0x01ff, 0xc03f, 0x803e, 0x41fe,
0x01fa, 0xc03a, 0x803b, 0x41fb, 0x0039, 0xc1f9, 0x81f8, 0x4038,
0x0028, 0xc1e8, 0x81e9, 0x4029, 0x01eb, 0xc02b, 0x802a, 0x41ea,
0x01ee, 0xc02e, 0x802f, 0x41ef, 0x002d, 0xc1ed, 0x81ec, 0x402c,
0x01e4, 0xc024, 0x8025, 0x41e5, 0x0027, 0xc1e7, 0x81e6, 0x4026,
0x0022, 0xc1e2, 0x81e3, 0x4023, 0x01e1, 0xc021, 0x8020, 0x41e0,
0x01a0, 0xc060, 0x8061, 0x41a1, 0x0063, 0xc1a3, 0x81a2, 0x4062,
0x0066, 0xc1a6, 0x81a7, 0x4067, 0x01a5, 0xc065, 0x8064, 0x41a4,
0x006c, 0xc1ac, 0x81ad, 0x406d, 0x01af, 0xc06f, 0x806e, 0x41ae,
0x01aa, 0xc06a, 0x806b, 0x41ab, 0x0069, 0xc1a9, 0x81a8, 0x4068,
0x0078, 0xc1b8, 0x81b9, 0x4079, 0x01bb, 0xc07b, 0x807a, 0x41ba,
0x01be, 0xc07e, 0x807f, 0x41bf, 0x007d, 0xc1bd, 0x81bc, 0x407c,
0x01b4, 0xc074, 0x8075, 0x41b5, 0x0077, 0xc1b7, 0x81b6, 0x4076,
0x0072, 0xc1b2, 0x81b3, 0x4073, 0x01b1, 0xc071, 0x8070, 0x41b0,
0x0050, 0xc190, 0x8191, 0x4051, 0x0193, 0xc053, 0x8052, 0x4192,
0x0196, 0xc056, 0x8057, 0x4197, 0x0055, 0xc195, 0x8194, 0x4054,
0x019c, 0xc05c, 0x805d, 0x419d, 0x005f, 0xc19f, 0x819e, 0x405e,
0x005a, 0xc19a, 0x819b, 0x405b, 0x0199, 0xc059, 0x8058, 0x4198,
0x0188, 0xc048, 0x8049, 0x4189, 0x004b, 0xc18b, 0x818a, 0x404a,
0x004e, 0xc18e, 0x818f, 0x404f, 0x018d, 0xc04d, 0x804c, 0x418c,
0x0044, 0xc184, 0x8185, 0x4045, 0x0187, 0xc047, 0x8046, 0x4186,

```
0x0182, 0xc042, 0x8043, 0x4183, 0x0041, 0xc181, 0x8180, 0x4040};
```

D.8 Status Flags Description [63,0,119]

The following table describes activities that set or reset status flags.

Table D-4. Status Flag Descriptions

Status Flag	Flag sets when…	Flag resets when…
Additive Selected	Operator selects additive through keypad. **Note**: If TAS writes additive selection to [63,0,60] then flag does not change.	▪ Transaction authorizes (in manual mode) ▪ Authorize Transaction command received (in auto mode) ▪ Prompt Additive command received. ▪ Additive selection screen is prompted (in manual mode). ▪ Operating mode changes. ▪ DL8000 powers on. ▪ Clear Status command received (in auto mode with bit 05h).
Batch Aborted (not started)	▪ Operator presses **Stop** key for authorized batch after entering preset volume (in manual mode). ▪ Operator issues Stop Batch command for authorized batch which is not in progress (in auto mode). ▪ TAS issues End Batch command for authorized batch which is not in progress (in auto mode). ▪ DL8000 powers up for a previously authorized batch which was not in progress when DL8000 powered down. **Note**: If authorized batch **was** running, flag resets. Batch number reduces by one.	▪ Clear Status command received (in auto mode with 0Eh bit). ▪ Authorize Batch command received (in auto mode). ▪ Batch authorizes (in manual mode). ▪ Operating mode changes.
Batch Authorized	▪ Batch authorizes (in manual mode). ▪ Authorize Batch command received (in auto mode).	▪ Batch ends (sets 0Dh). ▪ Batch aborts. ▪ DL8000 powers up.

Status Flag	Flag sets when…	Flag resets when…
Batch Ended	▪ End Batch command received when a batch is halted. ▪ Operator presses **Stop** key when batch is halted. ▪ Preset volume is delivered under normal circumstances. ▪ Batch halts (due to alarm or operator pressing **Stop**) and cannot be restarted. ▪ Operating mode changes. ▪ DL8000 powers on; batch was in progress when DL8000 powered down.	▪ Authorize Batch command received (in auto mode). ▪ Batch authorizes (in manual mode). ▪ Clear Status command received with 0Dh bit (in auto mode).
Batch in Progress	Batch starts/restarts. **Note**: Flag sets when operator presses **Start** or receipt of Start/Restart Batch command.	▪ Batch ends (sets 0Dh). ▪ DL8000 powers up. ▪ Operating mode changes.
Batch stopped (resumable)	▪ Batch halts due to alarm. ▪ Batch halts when operator presses **Stop** or receipt of Stop Batch command.	▪ Batch starts/restarts. **Note**: Flag resets when operator presses **Start** or receipt of Start/Restart Batch command. ▪ Batch ends. ▪ DL8000 powers up.
Flowing	Flow control valve opens.	▪ Flow control valve closes normally (due to alarm stop or operator pressing **Stop**). ▪ DL8000 powers up.
Intermediate level input alarm stopped batch	**Not currently implemented**	**Not currently implemented**
K&D Locked Out to Automation System	▪ Prompt Recipe, Prompt Additive, Prompt Preset, or Display Message commands received or Authorize Batch command in auto mode. ▪ Authorize Batch command received.	▪ Recipe is selected in response to Prompt Recipe command. ▪ Additive is selected in response to Prompt Additive command. ▪ Preset volume is entered in response to Prompt Preset Volume command. ▪ Data item entered in response to Display Message command. ▪ Batch ends. ▪ Batch aborts. ▪ Operation timeout flag is set. ▪ Primary alarm occurs which ends Prompt Recipe, Prompt Additive, Prompt Preset Volume or Display Message commands. ▪ Power-up DL8000.

Status Flag	Flag sets when…	Flag resets when…
Keypad Data Available	Operator enters keypad data. **Note**: This flag sets when the operator enters data items in response of auxiliary data prompts. When this flag sets, the TAS knows that operator has entered the data.	▪ Clear status command received (in auto mode with 07 bit). ▪ Display Message command received. ▪ Operating mode changes. ▪ DL8000 powers up.
Key Pressed	Operator presses any key.	Clear Status command is issued.
Operating Mode is Manual	▪ DL8000 powers up when operating mode [63,0,36] is manual. ▪ Operating mode changes from auto to manual by TAS or keypad.	▪ Operating mode is auto on power on. ▪ Operating mode changes from manual to auto by TAS, keypad, or digital input.
Operation Timed Out	▪ DL8000 is waiting for recipe selection, additive selection, preset volume entry, for start of batch, or displaying message and timeout occurs. ▪ Timeout Operation command is received on above given conditions.	▪ Prompt Recipe, Prompt Additive, Prompt Preset Volume, Display Message, or Authorize Batch command received (in auto mode). ▪ DL8000 powers up. ▪ Operating mode changes. ▪ Clear Status command received.
Primary Alarm	Primary (Highest severity) alarm is occurred.	No primary alarm is active. Reset a primary alarm using either the keypad or the Reset Primary Alarms command.
Passcode Entry in Progress	Operator starts entering passcode (sent by keypad module)	Operator finishes entering passcode (sent by keypad module).
Preset Volume Entered	Operator enters preset volume.	▪ Prompt Preset Volume command received (in auto mode). ▪ Preset volume prompt (in manual mode). ▪ Batch authorizes (in manual mode). ▪ Authorize Batch command received (in auto mode). ▪ Clear Status command received (in auto mode with bit 06). ▪ Operating mode changes. ▪ DL8000 powers up.
Program Code Value Changed	When recipe is configured using Configure Recipe command	Clear Status command issued.
Program Mode	DL8000 enters program mode.	DL8000 exits program mode.
Recipe Selected	Operator selects a recipe using the keypad. **Note**: If the TAS writes the recipe selection to [63,0,10] the flag	▪ Transaction authorizes (in manual mode). ▪ Authorize Transaction command received (in auto

Status Flag	Flag sets when…	Flag resets when…
	does not change.	mode). ▪ Prompt Recipe command received. ▪ Recipe selection screen is prompted (in manual mode). ▪ Operating mode changes. ▪ DL8000 powers up. ▪ Clear Status command received (in auto mode with bit 04h).
Batch In Configuration Mode	▪ W&M switch opens when batch is authorized. ▪ W&M switch status transitions from Closed to Open.	▪ W&M switch is closed when batch is authorized.
Transaction in Progress	First batch of authorized transaction starts.	▪ Transaction ends (that is, sets 0Ch). **Note**: Operating mode change forces end of transaction. ▪ DL8000 powers up.
Transaction Ended	▪ Operating mode changes while transaction in progress. ▪ DL8000 powers on while transaction was in progress when DL8000 powered down. ▪ End Transaction command received. **Note**: This command should be received when no batch is authorized (that is, a previous batch has either completed or aborted). ▪ Previous batch completes and operator presses **Stop** (in manual mode)	▪ Clear Status command received (in auto mode with 0Ch bit). ▪ Transaction authorizes (in manual mode). ▪ Authorized Transaction command received (in auto mode).

Status Flag	Flag sets when…	Flag resets when…
Transaction Authorized	▪ Transaction authorizes (in manual mode) ▪ Authorize Transaction command received (in auto mode).	▪ DL8000 powers up. ▪ Transaction ends or aborts. ▪ Operating mode changes and transaction authorizes. ▪ Operator presses **Stop** when for an authorized transaction and no batch is in progress (in manual mode). ▪ End Transaction command received (in auto mode) for an authorized transaction and no batch is in progress. ▪ DL8000 powers up when transaction was authorized but not started when DL8000 powered down. **Note**: Transaction number decreases by one.
Transaction End Requested	▪ In auto mode, transaction is authorized, no batch is authorized and operator presses **Stop** (that is, batching status is SELECT_RECIPE or BATCH_COMPLETE and **Stop** is pressed). ▪ In auto mode, transaction is authorized and batch is in progress and batch stopped at batching state is USER HALT, and operator presses **Stop**.	▪ Authorize Transaction command received. ▪ End Transaction command received. ▪ Clear Status command received (with 13h bit). ▪ Change Operating mode command ends transaction.

D.9 Exception Codes

In automatic mode, the TAS sends various commands to control the DL8000. Each command code can be accepted or rejected based on the DL8000 status. If the command is rejected, then the DL8000 generates an exception and writes the exception code to the TAS exception code [63,0,168].

With the DanLoad 6000 protocol, the exception code is **also** returned in the command response frame. Refer to the following table for descriptions of all exception codes.

Table D-5. Exception Codes

Exception # (hex value)	Description
FF	No Exception
00	Invalid command code
01	Passcode entry in progress
02	No transaction ended
03	Response's data field too long
04	Program code value is Weights and Measures
05	***Reserved***
06	No batch in progress
07	No transaction in progress
08	Batch in progress
09	Transaction in progress
0A	Primary alarm active (for severity 4 alarm)
0B	Batch authorized
0C	Transaction authorized
0D	***Reserved***
0E	No keypad data available
0F	Component not available
10	Additive not available
12	Status not set or cannot be reset
13	No additives configured
14	No batch authorized
15	Operating mode is manual
16	No preset volume entered
17	No recipe selected
18	No additive selection made
19	Data items not entered
1A	No key pressed
1C	Diagnostic not running.

Exception # (hex value)	Description
1D	Transaction not on file
1E	Batch not on file
1F	***Reserved***
21	***Reserved***
22	No transaction authorized
23	***Reserved***
24	K&D lock out
25	No batch stopped
26	No batch ended
27	Operating mode cannot be changed
28 to 3F	***Reserved***
40	Invalid recipe number
41	Invalid meter number
42	Invalid component number
43	Invalid transaction sequence number
44	Invalid program code
45	Invalid program code value
47	Invalid number of components
48	Invalid number of data items
4B	Invalid I/O point number
4C	Invalid output value
4D	Invalid operating mode
4E	Invalid additive selection method
4F	Invalid preset volume
50	Invalid date
51	Invalid time
53	Invalid override maximum preset volume
54	Invalid board type
55	Invalid bit #
56	Recipe Verification Fail
57	Maximum batches delivered for transaction
58	Invalid alarm ID
59	No string data to display
5A	In Program mode
5B	Tolerance Error
5C	Alarm active (for severity 2 and 3 alarms)
5D	Dependent user program is not in running state in Preset
5E	Unable to reset or raise the alarm
5F	Max Transaction Total
60	Flow Rate Too Low/High

Exception # (hex value)	Description
61	Weights and Measure locked

D.10 New/Unused DanLoad 6000 Exception Codes

The following exception codes have been **added** to the DanLoad 6000 protocol to support the DL8000. These codes are **not** present in the original DanLoad 6000 protocol.

Table D-6. New/Unused DanLoad 6000 Exception Codes

Exception # (hex value)	Description
56	Recipe Verification Fail
57	Maximum batches delivered for transaction
58	Invalid alarm ID
59	No string data to display
5A	In Program mode
5B	Tolerance Error
5C	Alarm active (for severity 2 and 3 alarms)
5D	Dependent user program is not in running state in Preset
5E	Unable to reset or raise the alarm
5F	Max Transaction Total
60	Flow Rate Too Low/High
61	Weights and Measure locked

The following exception codes, present in the original DanLoad 6000 protocol, are **not** used with the DL8000.

Exception # (hex value)	Description
11	Program code value is read only (not supported)
1B	Diagnostic not started. (not implemented)
20	Number of recipes less than 2 (not implemented)
46	Invalid CPU number (not implemented)
4A	Invalid I/O point type (not implemented)
52	Invalid data code (not implemented)

D.11 Alarm Logs

The DL800 uses the following alarms.

Table D-7. Alarm Logs

Alarm Name	Alarm ID	Name in Event Log
Unable to maintain blend	0	Blend Fail X
Configuration corrupted	1	Config corrupt
Parameter restored	2	Param restored
Over flow preset quantity	3	O.F. preset
Meter factor deviation – Meter X	4	MF Dev XXXX
Internal temperature failure	5	Intl temp fail
Linearization alarm – Meter X	6	Linr fail XXXX
System alarm – check log	7	System alarm
Safety Circuit1	8	
Safety Circuit2	9	
Safety Circuit3	10	
Safety Circuit4	11	
Safety Circuit5	12	
Safety Circuit6	13	
Safety Circuit7	14	
Safety Circuit8	15	
Instantaneous Blend X	16	Inst blend X
NaN found	17	NaN found
Data Error Found	17	Data Err Found **Note**: Supported only in Version 2.20 and greater.
Power failure	19	Power failure
Storage memory full	20	Stor mem full
Oup config corrupt	21	Oup conf corr
Oup parameter restored	22	Oup param rest
Storage memory pre-full	23	Sto mem pre **Note**: Supported only in Version 2.0 and greater.
Archive Error	24	Archive Error
Print Error	25	Print Error
K & D Com. Fail	26	KD Comm Fail

Group Alarm Name	Alarm ID	Name in Event Log
Flow rate too low – meter X	95 + meter no	Low Flow X

Group Alarm Name	Alarm ID	Name in Event Log
Flow rate too high – meter X	105 + meter no	High Flow X
Timed-out no flow detected – meter X	115 + meter no	No Flow X
Unauthorized flow	125 + meter no	Unauth Flow X
Unable to close valve – Meter X	135 + meter no	UT CI, Valve X
Valve closed early alarm – Meter X	145 + meter no	Under Flow X
Unable to ramp down – Meter X	155 + meter no	UT RampDown X
Additive Fail alarm – Additive X	165 + meter no	Additive X
Comm Fail alarm – Channel X	171 + meter no	Comm Fail X
Temperature Fail alarm	177 + meter no	Temp Fail
Pressure Fail alarm – Meter X	187 + meter no	Pres Fail
Density Fail alarm – Comp X	197 + meter no	Dens Fail
Valve Fail alarm	207 + meter no	Valve Fail X
Temperature drift alarm – Meter X	217 + meter no	Temp Drift X
Digital valve control fail alarm – Meter X	227 + meter no	Vlv Co Fail X
Pulse security alarm – Meter X	237 + meter no	Pulse Secur. X
Block Valve Fail – Comp X	247 + meter no	BV Fail X
Additive Fail Alarm – Additive X (additive 7 to additive 10)	81 + MAX additives (MAX additives = 10)	Additive X (where X is 7 to 10)

D.12 Error Codes

Following are error codes for the DL8000 protocol.

Table D-8. Error Codes

Error Code [63,0,95]	Reasons
0	No Error
1	Invalid recipe number
2	Incorrect delivery sequence or low proportion
3	Incorrect component ratios. This exception is raised if either of the following conditions is **not** satisfied. ▪ Total of component ratios of all components configured in the recipe must equal 100%. ▪ The component ratio of components not present in the recipe must be zero.
4	Invalid meter ID of a component used in the recipe.
5	Invalid valve ID, associated with a meter used by component used in the recipe.
6	Invalid primary component.
7	Target flow rate too low.
8	Target flow rate too high.
9	Incorrect side stream mask
10	Preset is not in the range of minimum and maximum preset.
11	Tolerance Allowed is **no** and blend ratio is out of the tolerance after considering the clean line quantity.
12	Number of batches delivered in current transaction is more than configured limit of maximum number of batches per transaction.
13	Transaction Total is greater than maximum transaction limit.
14	Archive configuration error.
15	Invalid additive selection.
16	Invalid preset additive option.
17	Invalid additive type.
18	Insufficient component preset.
19	Exceeded additive limit.
20	Reverse meter configured and delivery type not MAS
21	Reverse meter configured and unit type not sequential (auto/manual)

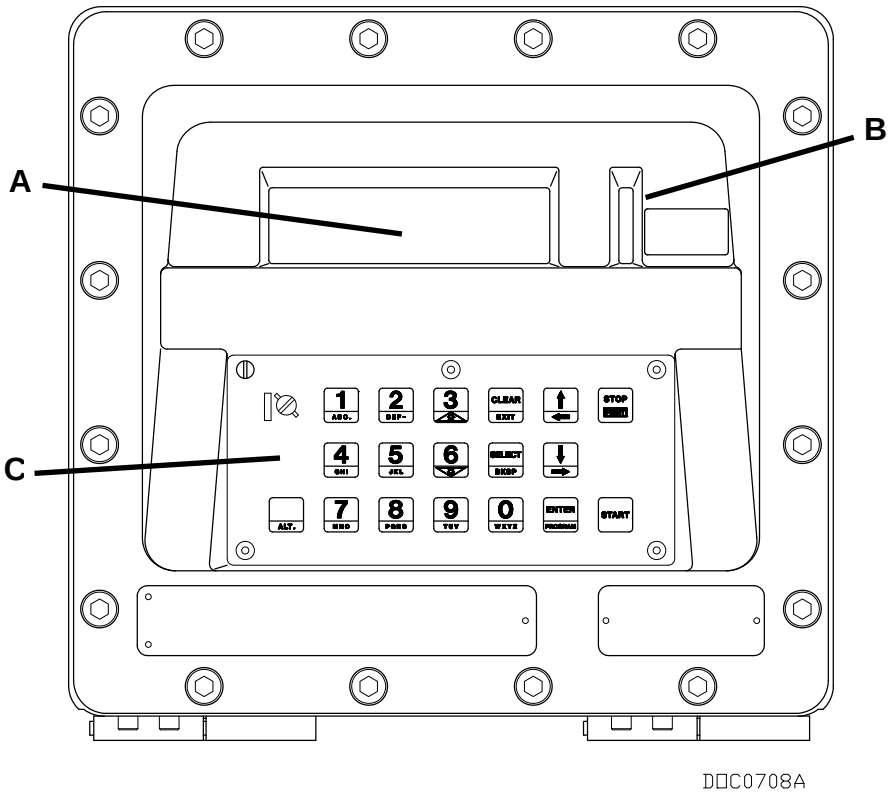
Appendix E – DL8000 Keypad Display

The DL800 keypad display enables you to interact with the DL8000. You can select recipes, enter the desired preset quantity, control batch deliveries, and—with appropriate authority—program the DL8000.

Warning **The keypad display uses port 2 (RS-232 on the CPU module) to communicate with the DL8000. The required baud rate for this port is 57.6K. Changing these values or assigning any other functionality to port 2 (such as the DanLoad 6000 or Modbus protocol) causes a communication failure to the keypad display.**

E.1 Keypad Display Components

The keypad display has the following parts:



A. Display

B. LED Status Indicators

C. Keypad

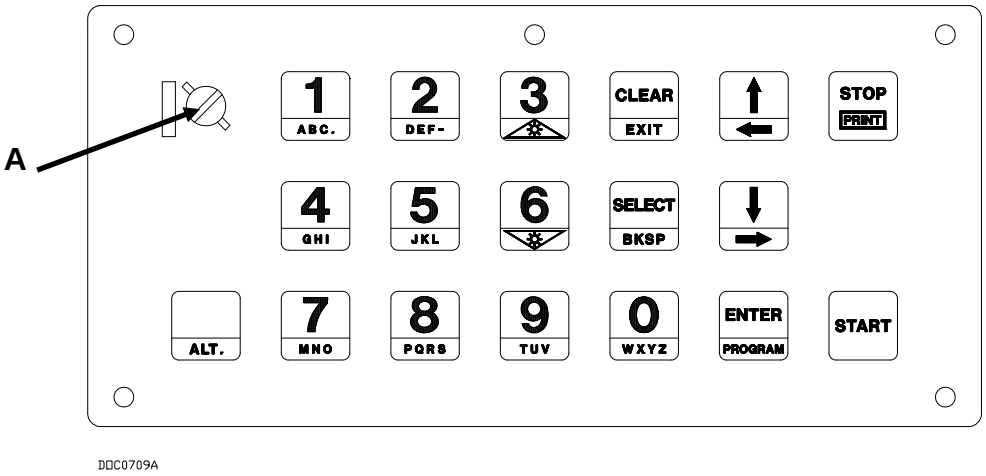
Figure E-1. DL8000 Keypad Display Interface

Component	Use
Keypad	Enables the operator to select recipes, enter the desired quantity, and control batch deliveries. **Note**: With appropriate authority, the operator can

Component	Use
	also program the DL8000.
Display	A liquid crystal display (LCD) panel divided into two sections (left and right). The left section supports eight rows of up to 19 characters and the right section supports eight lines of up to 20 characters. The display and keypad provide the primary method for operating the DL8000.
LED Status Indicators	Three light-emitting diodes (LEDs) display through the vertical window to the right of the LCD, indicating the DL8000's operational status.

E.1.1 Keypad

Using the keypad, you can select recipes, enter the desired preset quantity, control batch deliveries, and—with appropriate authority—program the DL8000. See *Figure E-2*.



A. Weights & Measures Switch

Figure E-2. DL8000 Keypad

Note: The Weights & Measures switch, located in the left upper corner of the keypad, is lockable and wire-sealable to restrict access to the flow calculations.

The keys on the keypad have both a primary value (when pressed alone) and alternate value (when pressed with the **ALT** key). *Table E-1* shows those values.

To select alternate key values, press and hold down the **ALT** key and press the key to display the alternate values. For example, press **ALT**+**1** to select **A**, **ALT**+**1** again to select **B**, and so on.

Note: The program validates what you can enter in any field. If a field accepts only numeric values, pressing **ALT**+**1** generates only the decimal. If the field accepts both alphabetic and numeric values, pressing **ALT**+**1** displays **A**, **B**, **C**, and the decimal.

Table E-1. Key Functions

Key/Alternate Value	Primary Function	Alternate Functions (ALT+)
ALT	Enables alternative functions on selected keys	Not applicable
1/ABC.	Numeric 1	A, B, C, and "." (decimal point)
2/DEF-	Numeric 2	D, E, F, and "-" (negative sign)
3	Numeric 3	▪ Increases display contrast (darken) when you select either contrast control menu or brightness control menu. **Note**: This function is available **only** in Program mode. ▪ Moves the display to next logical when the Status or Setup menu displays and display is on parameter screen. For example, if data for meter 1 (logical 0) is currently on screen, press ALT+3 to display data for meter 2 (logical 1).
4/GHI	Numeric 4	G, H, I, and " " (space)
5/JKL	Numeric 5	J, K, and L
6/	Numeric 6	▪ Decreases display contrast (brightens) when you select either contrast control menu or brightness control menu. **Note**: This function is available **only** in Program mode. ▪ Moves the display to previous logical when the Status or Setup menu displays and display is on parameter screen. For example, if data for meter 2 (logical 1) is currently on screen, press ALT+6 to display data for meter 1 (logical 0).
7/MNO	Numeric 7	M, N, and O
8/PQRS	Numeric 8	P, Q, R, and S
9/TUV	Numeric 9	T, U, and V
0/WXYZ	Numeric 0	W, X, Y, and Z
CLEAR/EXIT	Rejects the manually entered values	Accesses the next-highest menu in Program mode
SELECT/BKSP	Selects options while in loading or program mode.	Clears only last character/digit during data entry
⬆/⬅	Scrolls down in current display	Moves to next page in current menu
⬇/➡	Scrolls up in current display	Moves to previous page in current menu
ENTER/PROGRAM	Accepts the manually entered value and continues	Shows Login screen to enter Program mode (from Loading mode)

Key/Alternate Value	Primary Function	Alternate Functions (ALT+)
		Restores current value when in Setup menu and value entry is in progress
STOP/PRINT	Stops batch delivery or ends current transaction	Prints batch/transaction report (press ALT+STOP to initialize the Print command) **Note**: This key is active in program mode for the Print Record option.
START	Initiates the batch loading program after the batch setup data has been entered.	Not applicable

E.1.2 LED Status Indicators

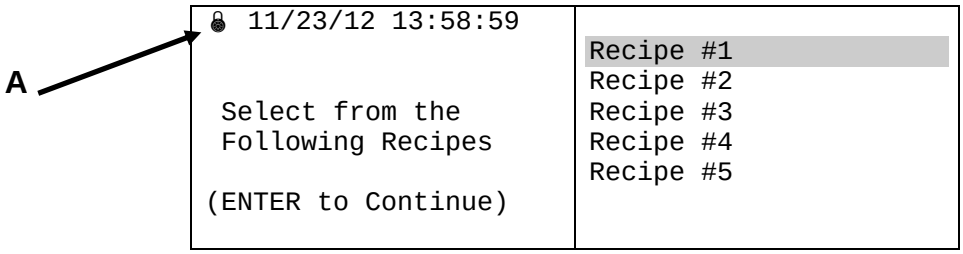
The yellow, red, and green LEDs (see *Figure E-1*) provide information about the DL8000's operational status.

Table E-2. LED Indicators

LED	Mode	Status	Function
YELLOW	Manual	Off	DL8000 is operating in Manual mode.
	Auto	On	DL8000 is operating in Auto mode (linked to a host computer and operating as a slave unit).
		Flashing	▪ **Two short pulses each second**: case internal temperature is too high. ▪ **One short pulse every two seconds**: Condition that caused the alarm has returned to normal. Power up the DL8000 or reset to continue using the keypad/display. ▪ **Rapid flashing:** Low power situation.
GREEN	Permissive Power	On	The permissive power circuit is closed (the normal state when a batch delivery is in progress). **Note**: The green LED indicator's function depends on the state of the permissive circuit (which is located in the power supply) and is not programmable.
		Off	The permissive power circuit is open. This indicates an abnormal state which is due to permissive power failure or failure of one or more permissive circuits wired in series (wired AND) with the permissive power source **Note**: The green LED indicator's function depends on the state of the permissive circuit (which is located in the power supply) and is not programmable.
RED	Alarm Status	On	A primary (or critical) alarm is active. You **must** clear this alarm before you can begin a new batch or new transaction.
		Off	All alarms are inactive.
		Flashing	A secondary (non-critical) alarm is active.

E.1.3 Liquid Crystal Display (LCD)

The DL8000 screen provides a Class 1, Div 1 liquid crystal display, which displays text, numbers, and graphics. The LCD has two halves: the left half displays 8 rows of 19 characters and the right half displays 8 rows of 20 characters (see *Figure E-3*). A single navigation program controls the screen.



A. Weights & Measures Icon (in closed or locked position)

Figure E-3. LCD Screen (Loading Mode)

The Weights & Measures icon (shown locked in *Figure E-3*) always appears in the upper left corner of the left-hand screen and indicates the current status of the Weights & Measures switch.

E.1.4 Power Failure

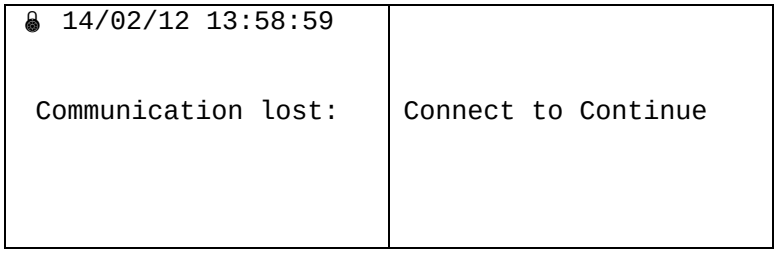
If power fails to the keypad display (but not to the DL8000 itself) for more than 5 seconds or if communications fail to the keypad display for more than 5 seconds, the system generates the Keypad Display Communications Failure (**K & D Com. Fail**) alarm (if you have previously configured it [TLP 64,0,42]).

In the event of **power** failure, the program redisplays the screen when power is restored. If the preset was in program mode when the power failure occurred, the keypad display program exits program mode and redisplays the most previous loading mode screen.

In the event of **communications** failure, the program redisplays the screen when communications are restored. If the preset was in program mode, the keypad display program exits program mode and redisplays the most previous loading mode screen.

Note: With a failure of either power or communications, the preset terminates the application selected with program mode.

The system displays this screen when communications fail between the DL8000 and the keypad display:



Note: You **cannot** resolve this communication failure from the keypad. You must use ROCLINK 800 to access the DL8000 and verify that the Keypad Display program is running, that port 2 is assigned to the LCD, and that the baud rate is 57.6K.

E.1.5 Operational Modes

The preset has two operational modes: **loading** and **program**. Loading mode enables operators to load product. Program mode provides access to more functions, including the ability to modify parameters within the preset. The security functions within the preset enable you to determine which system IDs can access which modes and functions. For further information on security, refer to *Section E.3, Program Mode*.

E.2 Loading Mode

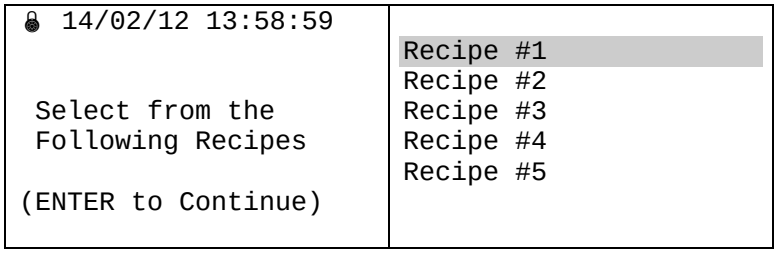
"Loading mode" is the normal mode of DL8000 operations. You use loading mode to perform all loading activities (such as batching, blending, and additive injections).

The following screens show the screen sequences during normal batch setup and delivery operations.

Note: Since you can easily change the content of the DL8000 displays, the screen in this section are **only** examples and may not correspond exactly to the appearance of the displays on your DL8000s.

E.2.1 Recipe Selection

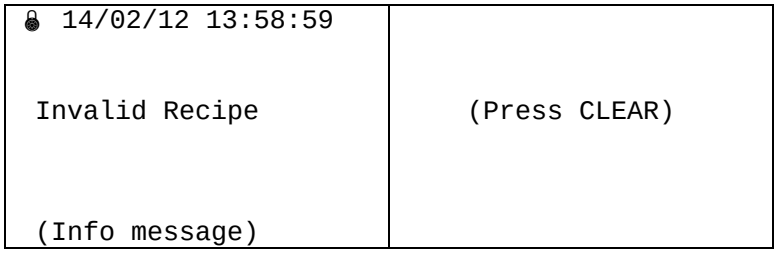
All configured recipes display in the Recipe Selection screen. The operator selects one of the recipes.



E.2.2 Invalid Recipe Selection

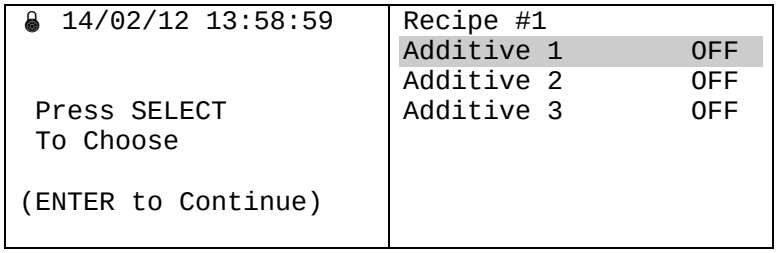
If the select recipe fails verification, the DL8000 displays the Invalid Recipe Selection screen:

Note: Refer to *Table 2-4* for possible information on error messages.



E.2.3 Additive Selection

If the system has at least one additive, the DL8000 displays the Additive Selection screen. The operator can then select the required additives.



Note: This screen displays **only** if you defined Additive Selection as a prompt. If you did not define Additive Selection as a prompt or if you defined the additive within the recipe, the DL8000 skips this screen and displays the Data Item Prompt screen.

E.2.4 Data Item Prompt

If you have configured at least one data item, the DL8000 displays the Data Item Prompt screen (where ***n*** indicates the data item).

Note: If you defined multiple data items, the DL8000 displays a data item screen for **each** data item defined.

14/02/12 13:58:59 Enter data item #n (ENTER to Continue)	Recipe #1 [ ]

E.2.5 Preset Quantity

The operator uses this screen to enter the preset quantity.

14/02/12 13:58:59 Enter Preset Quantity (ENTER to Continue)	Recipe #1 [ ] Bbl

Note: Use the Liquid Calcs program's Liquid Preference screen to set the units (here, **Bbl**) on this screen.

E.2.6 Invalid Preset

If the preset verification fails, the DL8000 displays this screen and provides an explanatory message at the bottom of the screen:

14/02/12 13:58:59 Invalid Preset... (Info Message)	Recipe #1 (Press CLEAR)

E.2.7 Loading

To provide the operator with critical feedback, the DL8000 always presents the loading screen during the definition of the batch delivery operation or during the transaction (delivery of batch or group of batches).

Note: The operator can press **ALT** + → to see dynamic data for Loading screens 2 and 3.

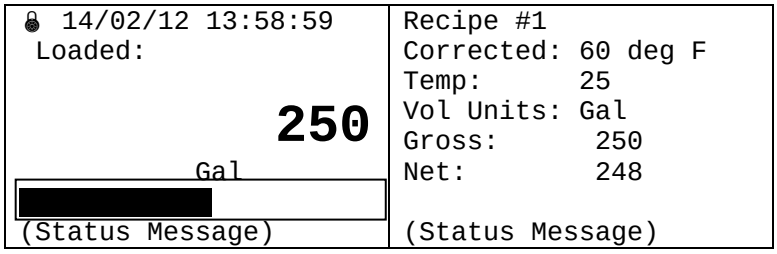


Table E-3 lists the possible status messages that could display on the Loading screen during various stages during the load:

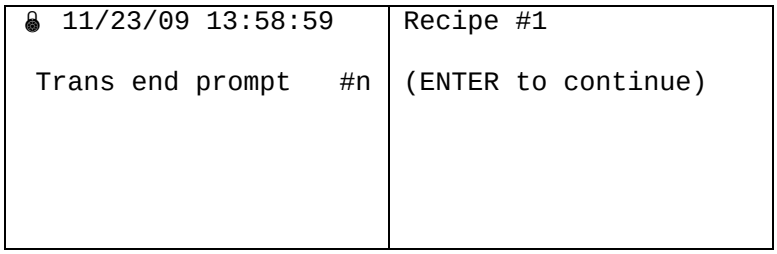
Table E-3. Loading Screen Status Messages

Message	Description
Start to Load	Press Start key to start loading
Line Pack delay	Indicates the pump for the component is running and loading line is being packed.
Load in Progress	Indicates the batch delivery is in progress in a normal manner.
Shutting Valve	Indicates that all open flow control valves are closing
Pump Stop Delay	Waiting for pump to close; flow control valve is already closed
Batch Halt	Indicates current batch is halted
Alarm Halt	Indicates current batch halted due to alarm
Transaction Ended	Indicates transaction has ended
Batch Aborted	Indicates batch has aborted
Batch Ended	Indicates batch has ended
Batch Complete	Indicated batch has completed after batch archiving
Opening BV	Indicates the block valve for the component is being opened
Archiving Batch	Indicates batch data is being archived
Archiving Transac	Indicates that transaction data archiving is occurring
Printing Ticket	Indicates the ticket is being printed
CRC Fail, Wait	Indicates the integrity check for user program images has failed
Prebatch Testing	Indicates the integrity check for user programs is running

E.2.8 Transaction End Prompt

If the operator selects at least one end transaction prompt, this screen displays during the transaction end sequence (***n*** indicates the end transaction prompt).

Note: If you defined multiple transaction prompts, the DL8000 displays **all** defined end transaction prompts in sequence.



E.2.9 Conditional String Display for Temperature Correction String

When no net volumes appear on the loading screen (either by the loading method or in the dynamic data), the Corrected to X deg C/F statement does not display. This message should display under any of the following conditions:

- If the Preset Delivery Type parameter [63,0,29] is set to **3**, Standard Volume (see *Table E-5* for more information)
- If the Type of Display Quantity parameter [63,0,30] is set to **1**, Net Standard Volume (see *Table E-5* for more information).
- If any of the totalizers configured on the dynamic data displays ([62,0,32] to [62,0,47]) is a **net** totalizer (see *Table E-4).*

Table E-4. Net Totalizers

TLP No.	**Meter Parameter**
75,X,7	Meter Net Std Volume (Unathorized)
75,X,12	Meter Net Std Volume (Batch)
75,X,17	Meter Net Std Volume (Authorized)
75,X,35	Transaction Start Net Std Reading
75,X,38	Transaction End Net Std Reading
75,X,41	Batch Start Net Std Reading
75,X,44	Batch End Net Std Reading
75,X,49	Meter Unauthorized Net Volume (Batch)
TLP No.	**Component Parameter**
69,X,27	Net Std Component Del Qty (Batch)
69,X,32	Net Std Component Total
TLP No.	**Recipe Parameter**
68,X,21	Recipe Net Std Del Qty
TLP No.	**Preset General Parameter**
63,0,137	Net Std Del Qty (Batch)
63,0,142	Net Std Del Qty (Transaction)
63,0,199	Net Unauthorized Transaction Qty
TLP No.	**Liquid Turbine Parameter**
73,X,33	Net Standard Volume Rate
73,X,34	Net Standard Volume Total

Note: **X** in the table refers to the number of the logical. Recipe, for example, can have up to 30 logicals while Meter can have a maximum of 4 logicals.

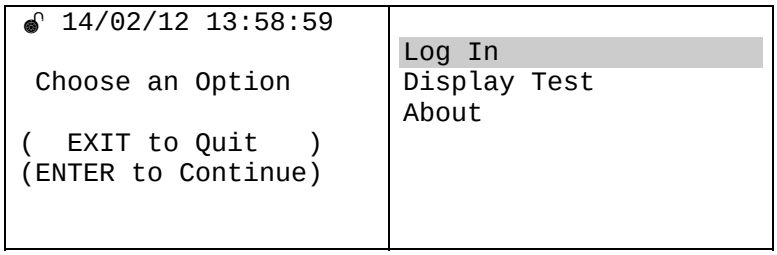
Table E-5. Preset Parameter Descriptions

TLP No.	Parameter	Description
63,0,29	Preset Delivery Type	Selects the quantity used for preset, loaded, and remaining quantities.
63,0,30	Type of Display	Selects the unit used for display purposes.

E.3 Program Mode

Warning **Using program mode, you can change metrology values on the DL8000. Consequently, you may need to unlock the Weights & Measures switch on your DL8000. Consult with your site's policies and procedures in case this is necessary.**

"Program mode" enables you—with appropriate access authority—to access and change components of the keypad display program. Access to program mode is possible through any of several "normal state" screens (Recipe Selection, Additive Selection, Loading, Preset Quantity, or Data Entry). Press **ALT**+**ENTER** on the keypad to display the primary program mode screen:



Note: Example screens in this section show an open (or unlocked) Weights & Measures icon.

E.3.1 ROCLINK 800 Configuration

You must set DL8000 security to enable an operator ID to access program mode. Alternately, you may use one of the two personal identification numbers (PINs) ROCLINK 800 provides to permit administrative access to the keypad display program.

Start ROCLINK 800 and double-click **Display #46, Navigation Setup** from the directory tree.

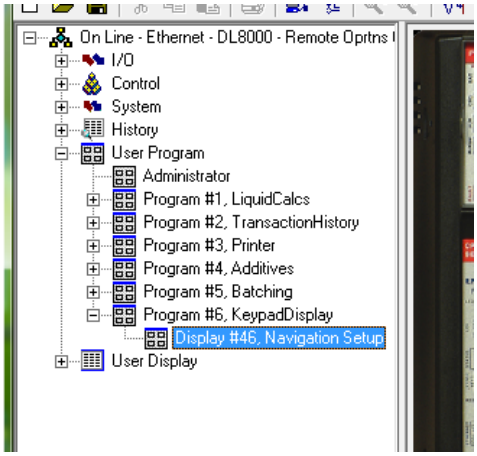
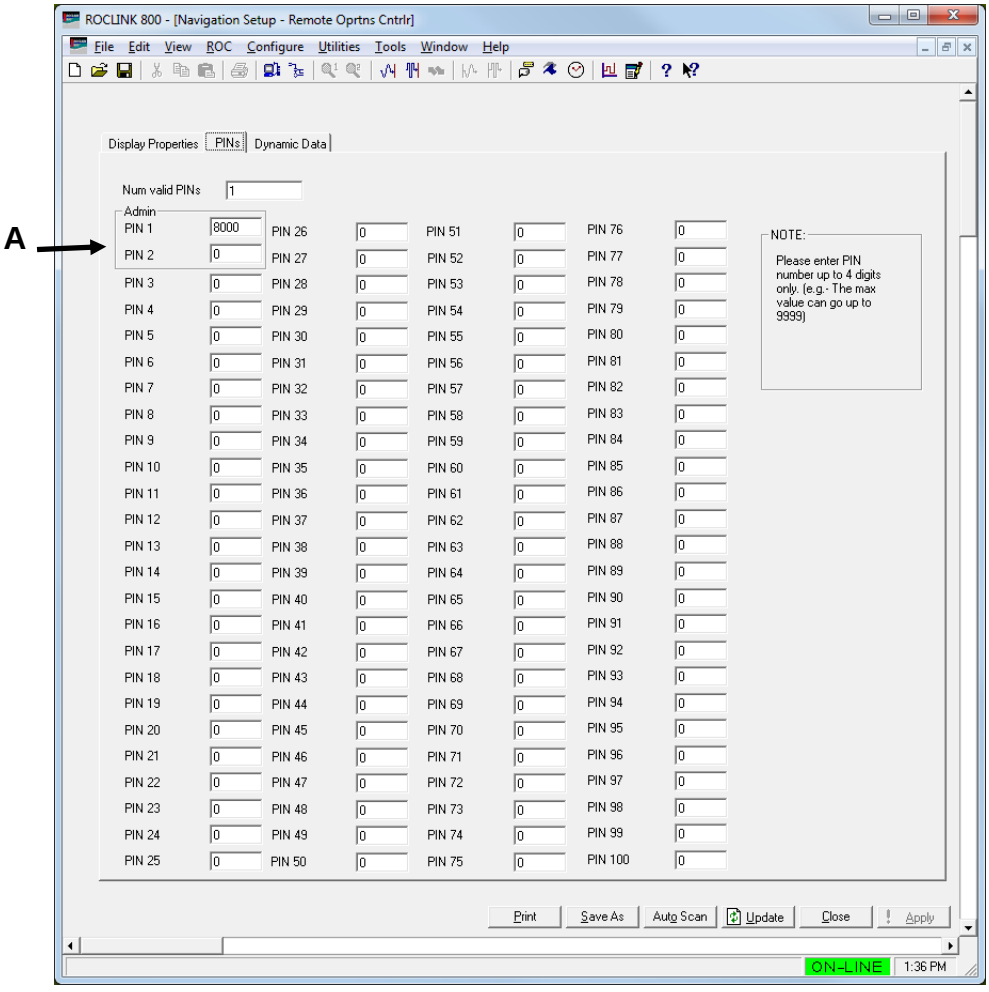


Figure E-4. Navigation Setup Option

The Navigation Setup screen displays. Select the **PINs** tab to display the PINs screen:



A. Default administrative PINs

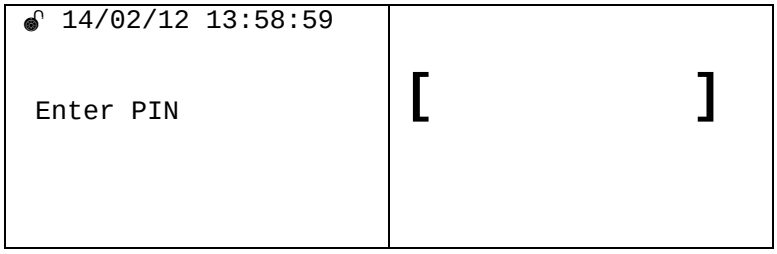
Figure E-5. PINs Screen

PIN 1 has a factory default of 8000; PIN 2 is blank. Define four-digit codes appropriate to your organization. Be sure to click **Apply** to save your changes.

Note: The two administrative PINs (1 and 2) can access **all** program mode options. Although all other PINs can access program mode, their access is limited to a subset of options (Clear Alarms, Select Language, Print Records, Display Settings, and Current Status).

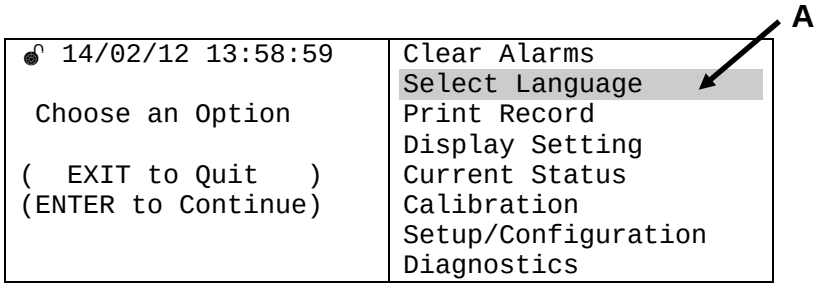
E.3.2 Log In

This screen displays when the operator selects **Log In** on the Program Mode screen. The operator completes this screen with a valid four-digit personal identification number (PIN) to access program mode screens.



E.3.3 Initial Menu

When you press **Enter**, the system display the Program main menu. The right-hand screen shows menu options.



A. Menu options (shading indicates current selection)

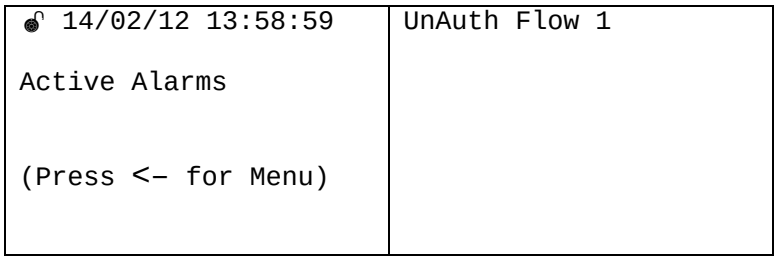
Option	Description
Clear Alarms	Views and clears existing alarms
Select Language	Changes language displayed for loading mode
Print Record	Reprints transaction ticket
Display Setting	Changes the brightness and contrast for the LCD
Calibration	Performs calibrations for analog inputs, RTDs, additive meters, and product meters **Note**: This option **does not displa**y if you do not have administrative privileges

Current Status	Displays status of all parameters (such as totalizers or alarm bits)
Setup/Configuration	Changes configurable parameters **Note**: This option **does not displa**y if you do not have administrative privileges
Diagnostics	Tests hardware (DO, DI, AO, AI, ACIO, and comm ports) **Note**: This option **does not displa**y if you do not have administrative privileges

E.3.4 Clear Alarms

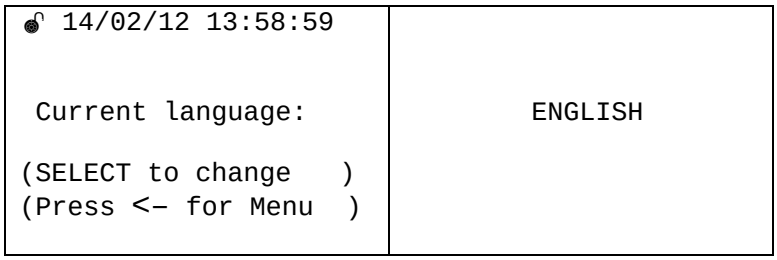
This screen displays when you select **Clear Alarms** on the Program Mode screen. Use it to view and clear alarms.

Note: Press **CLEAR** to clear an alarm.



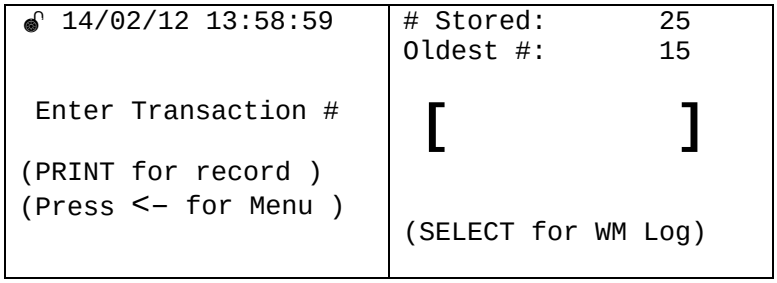
E.3.5 Select Language

This screen displays when you select **Select Language** on the Program Mode screen. Use it to adjust the language displayed for the DL8000 prompts.



E.3.6 Print Record

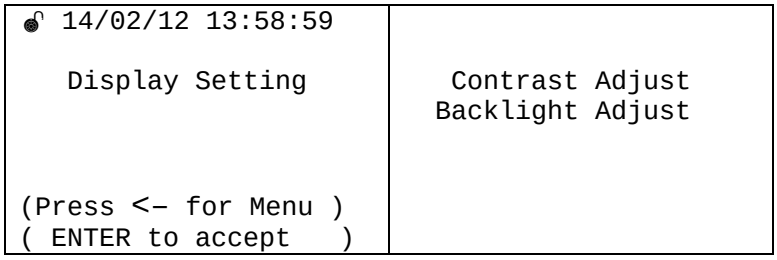
This screen displays when you select **Print Record** on the Program Mode screen. Use it to print the stored transaction record and Weights & Measures (WM) logs.



Note: For this screen, a valid range of transactions is between the oldest transaction number and the total number of transactions stored. The valid range for this screen would be from 15 to 39 (15+24=39).

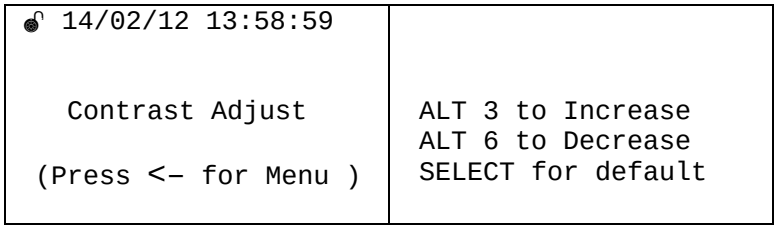
E.3.7 Display Setting

This screen displays when you select **Display Setting** on the Program Mode screen. Use it to adjust the backlighting and contrast on the display.



This menu has options you use to adjust the contrast or backlighting on the display.

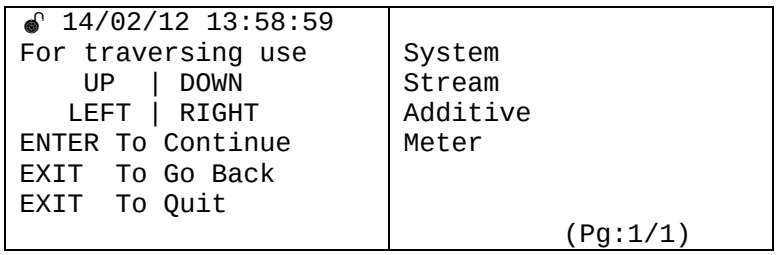
Adjust the Contrast Use this option to increase or decrease the contrast on the display. Press **SELECT** to restore the contrast to factory defaults. Press **ALT**+⬆ to return to the program menu.



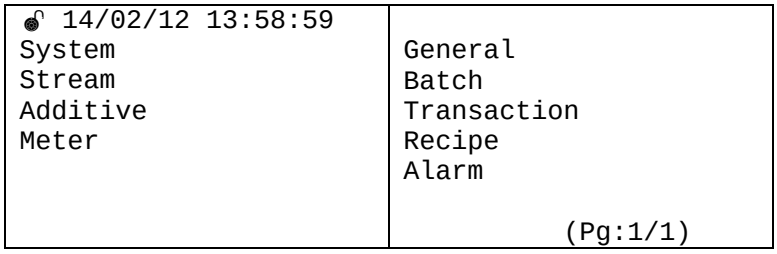
Adjust the Backlight Use this option to increase or decrease the backlighting on the display. Press **SELECT** to restore the backlight to factory defaults. Press **ALT**+⬆ to return to the program menu.

E.3.8 Current Status

Use this menu to review the status of parameters such as totalizers and alarms. You cannot change any of the displayed values. When you select **Current Status** on the Program Mode screen, the program displays an intermediate screen with navigational options:



Press **ENTER** to continue. The program displays the Current Status menu:



The keypad display program **does not** display **all** the TLPs in the preset. The program maintains a database which decides which TLPs you can access through the Current Status menu and under which submenu those TLPs reside. A TLP can be associated with any program or firmware. *Table E-6* shows which TLPs are available under which menu option.

Note: When the keypad display program is using the Setup/Configuration, Current Status, Calibration, or Diagnostics menu and an alarm occurs, the red LED blinks but no message displays.

Table E-6. TLPs in Current Status Menus

SYSTEM Menu		
General (1 logical, point type 63)	**Headings (Submenu Page 1)**	**TLP**
	Trans No.	63,0,20
	Batch No.	63,0,22
	LastPowerDownTime	63,0,21
	Current Alarm Type	63,0,9
	Roll Over Lmt	63,0,16
Batch (1 logical, point types 63 & 64)	**Headings (Submenu Page 1)**	**TLP**
	Batch Number	63,0,125

SYSTEM Menu		
	BtchStart DateTime	63,0,232
	Btch End Date Time	63,0,233
	Batch Gross Del.	63,0,135
	Batch Mass Del.	63,0,138
	Btch Net Std. Del.	63,0,137
	Headings (Submenu Page 2)	**TLP**
	Temp FWA	63,0,132
	Base Dens. FWA	63,0,179
	SwingArm Curr Side	63,0,145
	Net Mass Btch Tot	63,0,25
	Blend Curr Flowrate	63,0,59
	Cmpt Batch GrsDel	63,0,2
Transaction (1 logical, point types 63 & 64)	**Headings (Submenu Page 1)**	**TLP**
	Trans Number	63,0,124
	Trans Gross Del	63,0,140
	Trans Mass Del	63,0,143
	Trans Srt Dt Tm	63,0,230
	Trans End Dt Tm	63,0,231
	Trans Net Std Del	63,0,142
	Headings (Submenu Page 2)	**TLP**
	TransGrs UnauthQty	63,0,198
	TransNet UnauthQty	63,0,199
	Trans Mas Uauth Qt	63,0,200
	Cmpst Tran Grs Del	63,0,3
Recipe (1 logical, point type 68)	**Headings (Submenu Page 1)**	**TLP**
	Recipe Grs Del Qty	68,0,19
	Recp MassDel Qty	68,0,22
	RecipeNetStdDelQty	68,0,21
Alarm (1 logical, point type 63)	**Headings (Submenu Page 1)**	**TLP**
	Curr Alarm Type	63,0,64
	Out of Range Para1	63,0,201
	Out of Range Para2	63,0,202
	Out of Range Para3	63,0,203
	Out of Range Para4	63,0,204
	Out of Range Para5	63,0,205
	Headings (Submenu Page 2)	**TLP**
	Out of Range Para6	63,0,206

STREAM Menu		
Batch Reading (4 logicals, point type 69)	**Headings (Submenu Page 1)**	**TLP**
	Grs CompDel Qty	69,X,25
	Net CompDel Qty	69,X,27
	Mass CompDel Qty	69,X,28
	Actual comp %	69,X,59

STREAM Menu		
	FWA Comp Temp	69,X,61
	FWA Comp Press	69,X,72
	Headings (Submenu Page 2)	**TLP**
	FWA CompCTL	69,X,101
	FWA CompCPL	69,X,102
	FWA CompK Factor	69,X,103
	FWA Comp MF	69,X,104
	FWA CompObseDens	69,X,99
	FWA CompBaseDens	69,X,100
	Headings (Submenu Page 3)	**TLP**
	Low CompTemp	69,X,44
	High CompTemp	69,X,46
	Low CompPress	69,X,48
	High CompPress	69,X,50
	Low CompDens	69,X,52
	High CompDens	69,X,54
	Headings (Submenu Page 4)	**TLP**
	Low TempTimestamp	69,X,45
	High TempTimestamp	69,X,47
	Low PressTimestamp	69,X,49
	High PressTimestamp	69,X,51
	Low DensTimestamp	69,X,53
	High DensTimestamp	69,X,55
Running Total (4 logicals, point type 69)	**Headings (Submenu Page 1)**	**TLP**
	GrsCompTotal	69,X,30
	Net StdCompTotal	69,X,33
	Mass CompTotal	69,X,32

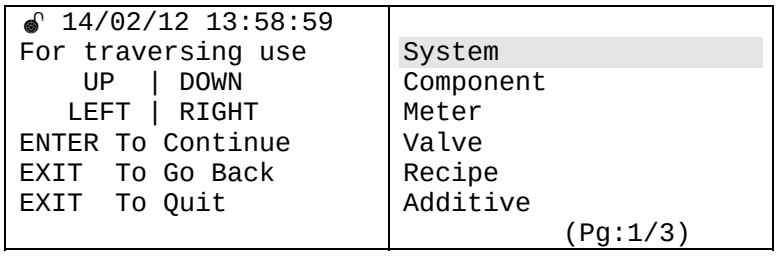
ADDITIVE Menu		
Totals (10 logicals, point type 67)	**Headings (Submenu Page 1)**	**TLP**
	Adtv BtchTotalizer	67,X,36
	AdtvTransTotalizer	67,X,37
	Adtv Runng Totzr	67,X,35
	Adtv Uauth Totzr	67,X,38
Vlv Closure Sample (10 logicals, point type 67)	**Headings (Submenu Page 1)**	**TLP**
	Pulse Sample 1	67,X,39
	Pulse Sample 2	67,X,40
	Pulse Sample 3	67,X,41
	Pulse Sample 4	67,X,42

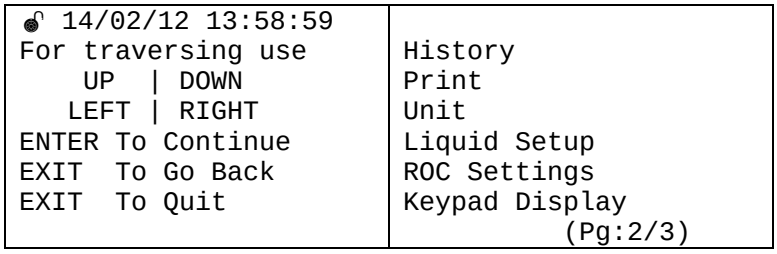
METER Menu		
Batch Reading (4 logicals, point type 75)	**Headings (Submenu Page 1)**	**TLP**
	Btch Meter Mass	75,X,13
	Btch Meter GrsVol	75,X,10

METER Menu		
	Btch Meter Net Vol	75,X,12
	RevBtch Mtr Mass	75,X,56
	RevBtch Mtr GrsVol	75,X,54
	RevBtch Mtr NetVol	75,X,55
	Headings (Submenu Page 2)	**TLP**
	UauthMtr Mass BchV	75,X,50
	UauthMtr Grs Bch V	75,X,48
	UauthMtr Net Bch V	75,X,49
Running Totals (4 logicals, point type 75)	**Headings (Submenu Page 1)**	**TLP**
	Meter Mass	75,X,18
	Meter GrsVol	75,X,15
	Meter Net Vol	75,X,17
	UnauthMtr Mass	75,X,8
	UnauthMtr GrsVol	75,X,5
	UnauthMtr Net Vol	75,X,7
Alarm (4 logicals, point type 69)	**Headings (Submenu Page 1)**	**TLP**
	Bad pulse count	75,X,57

E.3.9 Setup/ Configuration

This screen displays when you select **Setup/Configuration** on the Program Mode screen. This is the first of three screens. Press ⬇ to select the next option or press **ALT+**⬇ to move to the next screen:



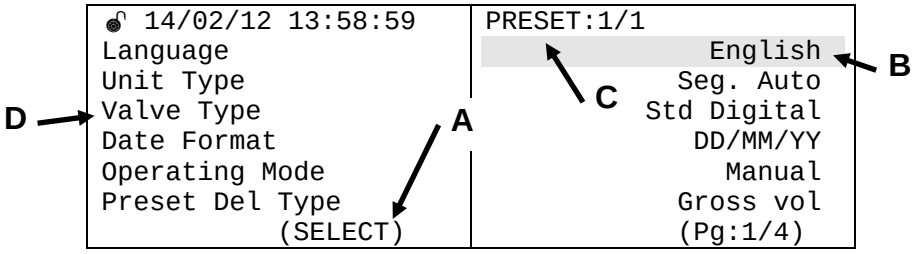


```
14/02/12 13:58:59          |
For traversing use         | Generic TLP Entry
    UP  | DOWN             | COM Port Settings
   LEFT | RIGHT            | Online Help
ENTER To Continue          |
EXIT  To Go Back           |
EXIT  To Quit              |
                           |          (Pg:3/3)
```

Press **ENTER** to access an option's submenu (such as System on the first screen):

```
14/02/12 13:58:59          |
System                     | General
Component                  | Flush
Meter                      | Adtv Inline Config
Valve                      | Prompt
Recipe                     | Driver Verificn
Additive                   | End O/P
                           |          (Pg:1/2)
```

An option may have additional options or may immediately display modifiable parameters:



A. Parameter value options

B. Editing indicator

C. Point type and logical of parameter

D. Parameter label

Note: Unlike menu options, parameter values display at the **right** side of the right-hand screen. Their corresponding labels display at the **left** side of the left-hand screen.

Parameter labels are limited to a maximum of 19 characters.

Changing a Parameter

To change a parameter value, use ⬆and ⬇ to move the highlighting to the parameter. Press **SELECT**. The final portion of the highlight line (**B**, above) blinks. This indicates that you intend to change this parameter's value.

The system also prompts you (see **A**, above) for the acceptable values for each parameter:

- **(SELECT)**
  Parameter has a set of **predefined** values. For instance, Date Format

has three predefined values: **DD/MM/YY**, **YY/MM/DD**, and **MM/DD/YY**. When you select that parameter, each time you press **SELECT** one of the predefined values displays. When you have the date format you want, press **ENTER**. The last portion of the highlighting stops blinking and the highlighting moves to the next value, indicating that the system has made your change.

- **(0–9)**
  Parameter accepts numeric entries only (digits 0 through 9)
- (**0–9, .**)
  Parameter accepts numeric entries (digits 0 through 9, negative sign, and the decimal point) and supports floating points (although not all parameters may support a negative sign or decimal point).
- (**A–Z, 0–9, .**)
  Parameter accepts alphanumeric entries, decimals points, negative signs, spaces, and supports floating points.
- (**TLP**)
  Parameter accepts a TLP value [0,0,0]. To define a TLP, press **SELECT**. The system displays valid IO module values. Press **ENTER** to define a module. (If you select a module which is not installed the message *Req. Card not in Sys* displays). The system prompts you to choose a logical. Press **SELECT** to page through the available values and press **ENTER** to choose a value. As soon as the system validates your selection, it prompts you to select a parameter. Press **SELECT** to page through the available values and press **ENTER** to choose a value. Press **ALT+ENTER** to cancel a selection while in data entry mode.

Note: **WM** displays in the last line of the right-hand screen if the selected parameter is a Weights & Measures parameter and the Weights & Measures switch is locked. In this case, you cannot edit this parameter.

Clearing a Value

If you make an error during data entry, either press **CLEAR** (to clear the entire entry) or use the BSKP key (**ALT+SELECT**) to clear just the last character entered. While you are entering data, you can restore the previous value by pressing **ALT+ENTER**.

Examples

To enter **AAA**, press and hold down **ALT.** Press **1**. The display first shows a decimal point, then A. Repeat the process twice.

To enter **ABC**, press and hold down **ALT**. Press **1** twice. Wait a second, and press **1** three times. Finally, press **1** four times.

Note: Pressing and holding down ALT and any key quickly displays all the values sequentially for that key (., A, B, and C in the case of the 1 key). Until you get used to the scroll speed, it is better to press the keys individually to make sure you have the right values.

A parameter group has parameters from a single point type. If the parameter is from different point type, then the display shows the point type name from last parameter only for whole screen

Setup Parameters

Table E-7 shows the menus, sub menus, and associated parameters under Setup/Configuration.

Table E-7. Menus & Submenus in Setup/Configuration

Menu	Sub-menu	Sub-menu
System	General	
	Flush	
	Inline Config	
	Prompt	
	Driver Verificn	
	End O/P	
	Alarm	Flow Alarm
		Process Alarm
		System Alarm
		Safety Alarm
		I/O Alarm
Component	General	
	Delivery	
	Meter Fac.Curve	
	IO points	
Meter	General	
	Alarm	
Valve	Digital Vlv.Cntrl	
	Digital Vlv. Band	
	IO points	
	Two Stage Vlv. Sett	
Recipe	General	
	Delivery	
	Adtv.Injection Mtd	General
		Adtv.Multirate
		Adtv.Qty.(control)
Additive	General	
	Delivery	
	Alarm	
	IO points	
History	General	
	Batch Hist Config	
	Trans Hist Config	
	Trans Hist Errors	

Menu	Sub-menu	Sub-menu
Print	General	
Unit	General	
Liquid Setup	Liquid Preference	
	Liquid Turbine	
	Liquid Product	
ROC Settings	General	
Keypad Display	Display Properties	
Generic TLP entry	Direct TLP Access	
COM port Settings	COM Parameters	
	BaudRate Generator	
	PortOwn. & Timeout	
PID Settings	PID Settings	
Online Help	Help Menu	
	Help Parameter	

Table E-8 shows the parameters and associated TLPs under each sub menu.

Note: If the menu supports more than one logical, use the key combinations **ALT**+**3** and **ALT**+**6** to access the last and next logical.

Table E-8. Parameters and TLPs in Setup/Configuration Menus

SYSTEM Menu			
General (1 logical, point type 63)	**Headings (Submenu Page 1)**	**TLP**	**Options(SELECT)**
	Language	63,0,14	English Spanish Portuguese
	Unit Type	63,0,12	Seq. Auto In-Line
	Vlv Type	63,0,13	Std Digital Std 2 Stage Analog Vlv
	Date Format	63,0,16	MM/DD/YY DD/MM/YY YY/MM/Dd
	Operating mode	63,0,36	Manual Auto
	Preset Del Type	63,0,29	Gross vol Net Std vol Mass
	Headings (Submenu Page 2)	**TLP**	
	No of Comp.	63,0,21	
	No of Meters	63,0,20	
	No of Recipes	63,0,26	
	No of MF	63,0,109	
	Stop Key Act	63,0,61	Low Flow

SYSTEM Menu			
			Immediate
	Use Restart Qty	63,0,115	No Yes
	Headings (Submenu Page 3)	**TLP**	
	Min. Preset	63,0,27	
	Max. Preset	63,0,28	
	Max Trans Limit	63,0,4	
	Batches/Trans	63,0,126	
	Display Qty Type	63,0,30	Gross vol Net Std vol Mass
	Legal Record	63,0,39	No record Printout History
	Headings (Submenu Page 4)	**TLP**	
	Swing 1 Input	63,0,8	
	Swing 2 Input	63,0,9	
	Auto Sel Recipe No	63,0,5	
	Auto Print Enable	63,0,249	No Yes
	Side detect mthd	63,0,7	Sgl w/o sw Sgl1 sw (SW2) Sgl 1 sw (SW1) Dbl 1 sw (SW2) Dbl 1 sw (SW1_ Dbl 2 sw
	Hist Data Rtn Days	63,0,43	
	Headings (Submenu Page 5)	**TLP**	
	Recovery Retries	63,0,22	
	Fallback Delay	63,0,23	
	Recovery Delay	63,0,31	
	Low Flw Cutoff	63,0,62	
	Rev. Vlv Cfg Opt	63,0,61	Single Act Vlv Double Act Vlv
Flush (1 logical, point type 63)	**Headings (Submenu Page 1)**	**TLP**	
	Primary Comp	63,0,33	
	Clean Line Qty	63,0,93	
	Tolerance Allowed	63,0,94	No Yes
Inline Config (1 logical, point type 63)	**Headings (Submenu Page 1)**	**TLP**	
	Blnd adjust vol	63,0,216	
	Blnd Tolerance %	63,0,148	
	Blnd cntrl delay	63,0,215	
	BlndLowFlowStrtQty	63,0,197	
	Rate Reduction	63,0,246	
	Corrc after Qty	63,0,212	
	Headings (Submenu Page 2)	**TLP**	
	Low set point	63,0,251	

SYSTEM Menu			
	Inter. Err. Limit	63,0,213	
	Max Fallback	63,0,212	
Prompt (1 logical, point type 63)	**Headings (Submenu Page 1)**	**TLP**	
	No of End prom	63,0,228	
	Data prompt 1	63,0,187	
	Data prompt 2	63,0,189	
	Data prompt 3	63,0,191	
	Data prompt 4	63,0,193	
	Data prompt 5	63,0,195	
	Headings (Submenu Page 2)	**TLP**	
	No of data items	63,0,186	
	Data item 1	63,0,188	
	Data item 2	63,0,190	
	Data item 3	63,0,192	
	Data item 4	63,0,194	
	Data item 5	63,0,196	
	Headings (Submenu Page 3)	**TLP**	
	Trans Endprom msg1	63,0,235	
	Trans Endprom msg2	63,0,236	
	Trans Endprom msg3	63,0,237	
	Trans Endprom msg4	63,0,238	
	Trans Endprom msg5	63,0,239	
Driver Verification (1 logical, point type 63)	**Headings (Submenu Page 1)**	**TLP**	
	Driver ID Check	63,0,245	Enable Disable
End O/P (1 logical, point type 63)	**Headings (Submenu Page 1)**	**TLP**	
	End i/p	63,0,129	
	End o/p	63,0,130	
	End Time(s)	63,0,128	
	End o/p Method	63,0,127	Batch only Trans Only Both
Alarm, Flow Alarm (1 logical, point type 63)	**Headings (Submenu Page 1)**	**TLP**	
	LowFlowAlmAct	63,0,17	Off Display Stop Batch Close Contact Lock Unit
	HighFlowAlmAct	63,0,18	Off Display Stop Batch Close Contact Lock Unit
	No Flow Alm Act	63,0,44	Off Display Stop Batch Close Contact Lock Unit

SYSTEM Menu			
	Vlv Fail Alm Act	63,0,220	Off Display Stop Batch Close Contact Lock Unit
	RampDownAlmAct	63,0,35	Off Display Stop Batch Close Contact Lock Unit
	UnderFlowAlmAct	63,0,42	Off Display Stop Batch Close Contact Lock Unit
	Headings (Submenu Page 2)	**TLP**	
	Low Flow Time	63,0,38	
	High Flow Time	63,0,40	
	No Flow Time	63,0,45	
	BV Time(s)	63,0,252	
	Vlv close Time(s)	63,0,221	
	RampDownTime	63,0,34	
	Headings (Submenu Page 3)	**TLP**	
	Unauth Flow Qty	63,0,46	Off Display Stop Batch Close Contact Lock Unit
	UnderFlow Lmt Qty	63,0,43	
	InstBlndAlmdelay	63,0,214	
	Blnd Alrm aftr Qt	63,0,217	
	Inst Blnd Alm Act	63,0,218	Off Display Stop Batch Close Contact Lock Unit
	Linear Alm Actn	63,0,219	Off Display Stop Batch Close Contact Lock Unit
	Headings (Submenu Page 4)	**TLP**	
	Max Badpulse Allwd	63,0,37	
	Badpulse Reset Opt	63,0,38	On bch autho On alrm gen
	MF Dev Alm Actn	63,0,223	Off Display Stop Batch Close Contact Lock Unit
	DgtlVlvFailAlmActn	63,0,240	Off Display Stop Batch Close Contact

SYSTEM Menu			
			Lock Unit
Alarm, Process Alarm (1 logical, point type 63)	**Headings (Submenu Page 1)**	**TLP**	
	Min Comp Temp	63,0,157	
	Max Comp Temp	63,0,158	
	Min Comp Dens	63,0,163	
	Max Comp Dens	63,0,164	
	Min Comp Press	63,0,160	
	Max Comp Press	63,0,161	
	Headings (Submenu Page 2)	**TLP**	
	Max perm Temp drft	63,0,225	
	Temp Fail Alm Act	63,0,181	Off Display Stop Batch Close Contact Lock Unit
	Press Fail Alm Act	63,0,182	Off Display Stop Batch Close Contact Lock Unit
	Dens Fail Alm Act	63,0,183	Off Display Stop Batch Close Contact Lock Unit
	Temp drift Alm act	63,0,224	Off Display Stop Batch Close Contact Lock Unit
Alarm, System Alarm (1 logical, point types 63 & 64)	**Headings (Submenu Page 1)**	**TLP**	
	Storage Mem Alm %	64,0,0	
	Max Allwd Dev Temp	63,0,229	
	ParamResAlmResTime	63,0,207	
	System Alm Act	63,0,146	Off Display Stop Batch Close Contact Lock Unit
	IntlTempFailAlmAct	63,0,227	Off Display Stop Batch Close Contact Lock Unit
	KD Comm Fail Alm	64,0,42	Off Display Stop Batch Close Contact Lock Unit
	Headings (Submenu Page 2)	**TLP**	
	Power Fail Alm Act	63,0,56	Off Display Stop Batch Close Contact

SYSTEM Menu			
			Lock Unit
	Calc Bound Alm Act	64,0,13	Off Display Stop Batch Close Contact Lock Unit
Alarm, Safety Alarm (1 logical, point types 63 & 64)	**Headings (Submenu Page 1)**	**TLP**	
	Circuit1 Alm Act	63,0,65	Off Display Stop Batch Close Contact Lock Unit
	Circuit2 Alm Act	63,0,67	Off Display Stop Batch Close Contact Lock Unit
	Circuit3 Alm Act	63,0,69	Off Display Stop Batch Close Contact Lock Unit
	Circuit4 Alm Act	63,0,71	Off Display Stop Batch Close Contact Lock Unit
	Circuit5 Alm Act	63,0,73	Off Display Stop Batch Close Contact Lock Unit
	Circuit6 Alm Act	63,0,75	Off Display Stop Batch Close Contact Lock Unit
	Headings (Submenu Page 2)	**TLP**	
	Circuit7 Alm Act	63,0,77	Off Display Stop Batch Close Contact Lock Unit
	Circuit8 Alm Act	63,0,79	Off Display Stop Batch Close Contact Lock Unit
	Circuit 1 Type	64,0,10	Side indepn If ldng at S1 If idng at S2
	Circuit 2 Type	64,0,11	Side indepn If ldng at S1 If idng at S2
	Circuit 3 Type	64,0,12	Side indepn If ldng at S1 If idng at S2

SYSTEM Menu			
	Circuit 4 Type	64,0,13	Side indepn If ldng at S1 If idng at S2
	Headings (Submenu Page 3)	**TLP**	
	Circuit 5 Type	63,0,81	Side indepn If ldng at S1 If idng at S2
	Circuit 6 Type	63,0,82	Side indepn If ldng at S1 If idng at S2
	Circuit 7 Type	63,0,83	Side indepn If ldng at S1 If idng at S2
	Circuit 8 Type	63,0,84	Side indepn If ldng at S1 If idng at S2
	Alm Msg 1	63,0,66	
	Alm Msg 2	63,0,68	
	Headings (Submenu Page 4)	**TLP**	
	Alm Msg 3	63,0,70	
	Alm Msg 4	63,0,72	
	Alm Msg 5	63,0,74	
	Alm Msg 6	63,0,76	
	Alm Msg 7	63,0,78	
	Alm Msg 8	63,0,80	
	Headings (Submenu Page 5)	**TLP**	
	Safety Circuit 1	63,0,85	
	Safety Circuit 2	63,0,86	
	Safety Circuit 3	63,0,87	
	Safety Circuit 4	63,0,88	
	Safety Circuit 5	63,0,89	
	Safety Circuit 6	63,0,90	
	Headings (Submenu Page 6)	**TLP**	
	Safety Circuit 7	63,0,81	
	Safety Circuit 8	63,0,92	
Alarm, I/O Alarm (1 logical, point types 63 & 64)	**Headings (Submenu Page 6)**	**TLP**	
	Alarm o/p 1	63,0,58	
COMPONENT Menu			
General (1 logical, point type 69)	**Headings (Submenu Page 1)**	**TLP**	
	Component ID	69,0,6	
	Pump Stop Delay(s)	69,0,5	
	Line Pack Delay(s)	69,0,10	
	BV Delay(s)	69,0,4	
Delivery (4 logicals, point type 69)	**Headings (Submenu Page 1)**	**TLP**	
	Meter	69,X,7	
	Final stop Qty	69,X,3	

COMPONENT Menu			
	Low Flw Strt Qty	69,X,0	
	Low Flw Stop Qty	69,X,2	
	Low Flw Rstrt Qty	69,X,1	
	LP High Flow Rate	69,X,57	
	Headings (Submenu Page 2)	**TLP**	
	Stop Flow Rate	69,X,56	
Meter Fac. Curve (4 logicals, point type 69)	**Headings (Submenu Page 1)**	**TLP**	
	M-Fact/K-Fact Optn	69,X,74	Sgl MF & Sgl KF MF Crv & Sgl KF
	M-Fact	69,X,9	
	K-Fact	69,X,8	
	M-Fact/K-Fact 1	69,X,75	
	M-Fact/K-Fact 2	69,X,77	
	M-Fact/K-Fact 3	69,X,79	
	Headings (Submenu Page 2)	**TLP**	
	M-Fact/K-Fact 4	69,X,81	
	M-Fact/K-Fact 5	69,X,83	
	M-Fact/K-Fact 6	69,X,85	
	M-Fact/K-Fact 7	69,X,87	
	M-Fact/K-Fact 8	69,X,89	
	M-Fact/K-Fact 9	69,X,91	
	Headings (Submenu Page 3)	**TLP**	
	M-Fact/K-Fact 10	69,X,93	
	M-Fact/K-Fact 11	69,X,95	
	M-Fact/K-Fact 12	69,X,97	
	Flowrate/Freq 1	69,X,76	
	Flowrate/Freq 2	69,X,78	
	Flowrate/Freq 3	69,X,80	
	Headings (Submenu Page 4)	**TLP**	
	Flowrate/Freq 4	69,X,82	
	Flowrate/Freq 5	69,X,84	
	Flowrate/Freq 6	69,X,86	
	Flowrate/Freq 7	69,X,88	
	Flowrate/Freq 8	69,X,90	
	Flowrate/Freq 9	69,X,92	
	Headings (Submenu Page 5)	**TLP**	
	Flowrate/Freq 0	69,X,94	
	Flowrate/Freq 11	69,X,96	
	Flowrate/Freq 12	69,X,98	
IO Points (4 logicals, point type 69)	**Headings (Submenu Page 1)**	**TLP**	
	BV1 Contact	69,X,64	
	BV1 Feedbck	69,X,68	
	Pump Contact	69,X,12	

METER Menu			
General (4 logicals, point type 75)	**Headings (Submenu Page 1)**	**TLP**	
	Meter ID	75,X,1	
	Mtr Flow Direction	75,X,52	Normal flow Revs flow
	Rev Meter Vlv Sov1	75,X,85	
	Rev Meter Vlv Sov2	75,X,86	
	Sov1 Ret time	75,X,87	
	Sov2 Ret time	75,X,88	
	Headings (Submenu Page 2)	**TLP**	
	Rev MF/KF Optn	75,X,58	Sgl MF & Sgl KF MF Crv & Sgl KF
	Rev Meter M-Fact	75,X,84	
	Rev Meter K-Fact	75,X,83	
	Rev Meter MF/KF 1	75,X,59	
	Rev Meter MF/KF 2	75,X,61	
	Rev Meter MF/KF 3	75,X,63	
	Headings (Submenu Page 3)	**TLP**	
	Rev Meter MF/KF 4	75,X,65	
	Rev Meter MF/KF 5	75,X,67	
	Rev Meter MF/KF 6	75,X,69	
	Rev Meter MF/KF 7	75,X,71	
	Rev Meter MF/KF 8	75,X,73	
	Rev Meter MF/KF 9	75,X,75	
	Headings (Submenu Page 4)	**TLP**	
	Rev Meter MF/KF 10	75,X,77	
	Rev Meter MF/KF 11	75,X,79	
	Rev Meter MF/KF 12	75,X,81	
	RevFlowrate/Freq 1	75,X,60	
	RevFlowrate/Freq 2	75,X,62	
	RevFlowrate/Freq 3	75,X,64	
	Headings (Submenu Page 5)	**TLP**	
	RevFlowrate/Freq 4	75,X,66	
	RevFlowrate/Freq 5	75,X,68	
	RevFlowrate/Freq 6	75,X,70	
	RevFlowrate/Freq 7	75,X,72	
	RevFlowrate/Freq 8	75,X,74	
	RevFlowrate/Freq 9	75,X,76	
	Headings (Submenu Page 6)	**TLP**	
	RevFlowrate/Freq10	75,X,78	
	RevFlowrate/Freq11	75,X,80	
	RevFlowrate/Freq12	75,X,82	
Alarm (4 logicals, point type 75)	**Headings (Submenu Page 1)**	**TLP**	
	Min Flow Rate	75,X,2	
	Max Flow Rate	75,X,3	
	Temp Probe 1 TLP	75,X,31	

METER Menu			
	Temp Probe 2 TLP	75,X,32	

VALVE Menu			
Digital Vlv. Cntrl (1 logical, point type 63)	**Headings (Submenu Page 1)**	**TLP**	
	Recovery Retries	63,0,22	
	Recovery Delay(s)	63,0,31	
	Fallback Delay(s)	63,0,23	
Digital Vlv. Band (4 logicals, point type 76)	**Headings (Submenu Page 1)**	**TLP**	
	LF % Error	76,X,1	
	HF % Error	76,X,2	
IO Points (4 logicals, point type 76)	**Headings (Submenu Page 1)**	**TLP**	
	Solenoid 1	76,X,4	
	Solenoid 2	76,X,5	
2 Stage Sett (4 logicals, point type 76)	**Headings (Submenu Page 1)**	**TLP**	
	Solenoid 1	76,X,4	
	Solenoid 2	76,X,5	
	Stem Switch 1	76,X,6	
	Stem Switch 2	76,X,7	

RECIPE Menu			
General (30 logicals, point type 68)	**Headings (Submenu Page 1)**	**TLP**	
	Name	68,X,0	
Delivery (30 logicals, point type 68)	**Headings (Submenu Page 1)**	**TLP**	
	% of Comp 1	68,X,1	
	% of Comp 2	68,X,2	
	% of Comp 3	68,X,3	
	% of Comp 4	68,X,4	
	Recp HF Rate	68,X,24	
	Recp LF Strt Rate	68,X,23	
	Headings (Submenu Page 2)	**TLP**	
	Del Seq or LowProp	68,X,17	
	Flushing	68,X,5	No Yes
Adtv. Injection Mtd, General (30 logicals, point type 68)	**Headings (Submenu Page 1)**	**TLP**	
	Adtv 1 cntrlComp	68,X,31	
	Adtv 2 cntrlComp	68,X,32	
	Adtv 3 cntrlComp	68,X,33	
	Adtv 4 cntrlComp	68,X,34	
	Adtv 5 cntrlComp	68,X,35	
	Adtv 6 cntrlComp	68,X,36	
	Headings (Submenu Page 2)	**TLP**	
	Adtv 7 cntrlComp	68,X,49	
	Adtv 8 cntrlComp	68,X,50	
	Adtv 9 cntrlComp	68,X,51	

RECIPE Menu			
	Adtv 10 cntrlComp	68,X,52	
	Recipe Additives	68,X,53	
Adtv. Injection Mtd, Adtv. Multirate (30 logicals, point type 68)	**Headings (Submenu Page 1)**	**TLP**	
	Add 1 Ratio Qty	68,X,7	
	Add 2 Ratio Qty	68,X,8	
	Add 3 Ratio Qty	68,X,9	
	Add 4 Ratio Qty	68,X,10	
	Add 5 Ratio Qty	68,X,11	
	Add 6 Ratio Qty	68,X,12	
	Headings (Submenu Page 2)	**TLP**	
	Add 7 Ratio Qty	68,X,13	
	Add 8 Ratio Qty	68,X,14	
	Add 9 Ratio Qty	68,X,15	
	Add 10 Ratio Qty	68,X,16	
Adtv. Injection Mtd, Adtv. Qty. (control) (30 logicals, point type 68)	**Headings (Submenu Page 1)**	**TLP**	
	Add 1 Qty/Inj	68,X,37	
	Add 2 Qty/Inj	68,X,38	
	Add 3 Qty/Inj	68,X,39	
	Add 4 Qty/Inj	68,X,40	
	Add 5 Qty/Inj	68,X,41	
	Add 6 Qty/Inj	68,X,42	
	Headings (Submenu Page 2)	**TLP**	
	Add 7 Qty/Inj	68,X,43	
	Add 8 Qty/Inj	68,X,44	
	Add 9 Qty/Inj	68,X,45	
	Add 10 Qty/Inj	68,X,46	
ADDITIVE Menu			
General (1 logical, point types 63 & 64)	**Headings (Submenu Page 1)**	**TLP**	
	No of Additives	63,0,100	
	Add Error Limit	63,0,103	
	AddErrorLimitcntrl	63,0,184	
	Add Clean Line Qty	63,0,104	
	Adtv Cleanline O/p	63,0,107	
	Adtv Flush O/p	63,0,105	
	Headings (Submenu Page 2)	**TLP**	
	Add K-factor Unit	64,0,1	CC Inch3 Gallons (US) Liters Barrels FT3 M3
	AddSelectionMthd	63,0,102	CC Inch3 Gallons (US) Liters

ADDITIVE Menu			
			Barrels FT3 M3
	Preset Add Option	64,0,26	Prompt Discrete I/P Recp Sel Recp Mlti Rt
	Add PumpStopDelay	63,0,106	Exclusive Inclusive
Delivery (10 logicals, point type 67)	**Headings (Submenu Page 1)**	**TLP**	
	Ratio Qty	67,X,27	
	Add M-Fact	67,X,28	
	Volume per Pulses	67,X,2	
	Rtaio Cycle Inj %	67,X,17	
	Additive Type	67,X,8	Downstream Upstream
	Vlv Closure Qty	67,X,47	Manual Auto
	Headings (Submenu Page 2)	**TLP**	
	Inj Method	67,X,1	Mechanical Handshake Control
	Add Feedback Count	67,X,2	
Alarm (10 logicals, point type 67)	**Headings (Submenu Page 1)**	**TLP**	
	Prod/AdtvLowLimit	67,X,20	
	Prod/AdtvHiLimit	67,X,21	
	AdtvUnAuthPlsRes T	67,X,44	
	Unauth Add Pulses	67,X,29	
IO Points (10 logicals, point type 67)	**Headings (Submenu Page 1)**	**TLP**	
	Add Pump Output	67,X,9	
	Add Fb i/p	67,X,7	
	Adtv BV O/p	67,X,11	
	Adtv Ratio Vlv O/p	67,X,6	
	Discrete i/p Sel	67,X,26	

HISTORY Menu			
General (1 logical, point type 61)	**Headings (Submenu Page 1)**	**TLP**	
	Archive Btch/Trans	61,0,145	
	Requested Max Tx	61,0,146	
	Max no.Batch Archv	61,0,127	
	Max no.Trans Archv	61,0,121	
	StoMemFul AlmCfg	61,0,130	
	No of Rec to clear	61,0,125	
	Headings (Submenu Page 2)	**TLP**	
	Clear History Opt	61,0,124	Choose An Option Clr Num of Records Release & Acquire

HISTORY Menu

Batch Hist Config
(1 logical, point type 61 & 65)

Headings (Submenu Page 1)	TLP	
Pressure (FWA)	61,0,6	Disabled Enabled
Preset Qty	61,0,9	Disabled Enabled
Gross Qty (Compo.)	61,0,245	Disabled Enabled
Mass	61,0,12	Disabled Enabled
Comp. Gross Qty	61,0,13	Disabled Enabled
Comp. Net Qty	61,0,14	Disabled Enabled

Headings (Submenu Page 2)	TLP	
Comp. Mass	61,0,15	Disabled Enabled
Comp. Temp	61,0,16	Disabled Enabled
Comp. Press	61,0,152	Disabled Enabled
Comp. Base Density	61,0,153	Disabled Enabled
Comp. Obs. Density	61,0,225	Disabled Enabled
Comp. 1 %	61,0,17	Disabled Enabled

Headings (Submenu Page 3)	TLP	
Comp. 2 %	61,0,141	Disabled Enabled
Comp. 3 %	61,0,142	Disabled Enabled
Comp. 4 %	61,0,143	Disabled Enabled
Actual Cmp %	61,0,18	Disabled Enabled
Adtv Gross Qty	61,0,19	Disabled Enabled
Operating Mode	61,0,20	Disabled Enabled

Headings (Submenu Page 4)	TLP	
Meter Start Ind.	61,0,195	Disabled Enabled
Meter End Ind.	61,0,196	Disabled Enabled
Component K-Fact	61,0,205	Disabled Enabled
Component MF	61,0,206	Disabled Enabled
Component CTL	61,0,215	Disabled Enabled
Component CPL	61,0,216	Disabled

HISTORY Menu			
			Enabled
	Headings (Submenu Page 5)	**TLP**	
	NetForward Mass	65,0,12	Disabled Enabled
	Reverse Meter Mass	65,0,14	Disabled Enabled
	Meter Mass Batch	65,0,19	Disabled Enabled
Trans Hist Config (1 logical, point type 61)	**Headings (Submenu Page 1)**	**TLP**	
	Recipe Number	61,0,22	Disabled Enabled
	Data Item 1	61,0,23	Disabled Enabled
	Data Item 2	61,0,24	Disabled Enabled
	Data Item 3	61,0,25	Disabled Enabled
	Data Item 4	61,0,26	Disabled Enabled
	Data Item 5	61,0,27	Disabled Enabled
	Headings (Submenu Page 2)	**TLP**	
	Start Date/Time	61,0,28	Disabled Enabled
	Gross Start Qty	61,0,33	Disabled Enabled
	Gross End Qty	61,0,36	Disabled Enabled
	Gross Qty	61,0,30	Disabled Enabled
	Gross Qty (Compo.)	61,0,247	Disabled Enabled
	Net Start Qty	61,0,34	Disabled Enabled
	Headings (Submenu Page 3)	**TLP**	
	Net end Qty	61,0,37	Disabled Enabled
	Net Qty	61,0,31	Disabled Enabled
	Mass Start	61,0,35	Disabled Enabled
	Mass End	61,0,38	Disabled Enabled
	Mass	61,0,32	Disabled Enabled
	Adtv Gross Qty	61,0,39	Disabled Enabled
	Headings (Submenu Page 4)	**TLP**	
	Swing Arm Side	61,0,231	Disabled Enabled
Trans Hist Errors	**Headings (Submenu Page 1)**	**TLP**	

HISTORY Menu			
(1 logical, point type 61)	Trans. Cfg Error	61,0,133	Read only
	Batch Cfg Error	61,0,134	Read only
	Acquire Mem Fail	61,0,144	Read only

PRINT Menu			
General (1 logical, point type 60)	**Headings (Submenu Page 1)**	**TLP**	
	Display Tag	60,0,0	
	Printer Type	60,0,23	Serial Ethernet
	Printer Port	60,0,2	
	Char Per Inches	60,0,9	Four Six Eight Twelve Fourteen Sixteen
	Printer IP Address	60,0,1	
	Print Orientation	60,0,12	Portrait Landscape
	Headings (Submenu Page 2)	**TLP**	
	Trgt Disp To Print	60,0,7	

UNIT Menu			
General (1 logical, point type 70)	**Headings (Submenu Page 1)**	**TLP**	
	Mass Unit	70,0,7	Lb Kg Ton Tonne
	Volume Unit	70,0,6	Gallons (US) Mfc Km3
	Density Unit	70,0,3	Kg/m3 g/cm3 Lb/ft3 Lb/bbl Relative Density API Gravity
	Pressure Unit	70,0,1	Psi Kpa Bar Kg/cm2
	Temperature Unit	70,0,2	Deg C Deg F
	Flow Rate Option	70,0,8	Per Minute Per Hour Per Second Per Day

LIQUID SETUP Menu			
Liquid Preference (1 logical, point type 70)	**Headings (Submenu Page 1)**	**TLP**	
	Press Unit Option	70,0,1	Psi

LIQUID SETUP Menu			
			Kpa Bar Kg/cm2
	Temp Units Option	70,0,2	Deg C Deg F
	Dens Unit Option	70,0,3	Kg/m3 g/cm3 Lb/ft3 Lb/bbl Relative Density API Gravity
	Volume Unit Option	70,0,6	Gallons (US) Mfc Km3
	Mass Unit Option	70,0,7	Lb Kg Ton Tonne
	Flowrate Option	70,0,8	Per Minute Per Hour Per Second Per Day
	Headings (Submenu Page 2)	**TLP**	
	Corr.Table Option	70,0,11	Relative Density API Gravity Kg/m3
Liquid Turbine (4 logicals, point type 73)	**Headings (Submenu Page 1)**	**TLP**	
	Flow Meter Input	73,X,20	
	Meter Temp Input	73,X,22	
	Meter Press Input	73,X,21	
	Base Temp Option	73,X,9	Base Temp: 15DegC Base Temp: 20DegC Base Temp: 30DegC Base Temp: 60DegF
	Density Option	73,X,16	Use Prod Density Use Meter Density
Liquid Product (5 logicals, point type 72)	**Headings (Submenu Page 1)**	**TLP**	
	Fluid Type	72,X,1	Gasoline Jet fuel Fuel oil Lube oil Special Appn Light Hydrocarbon Ethanol Crude oil
	PetroMeas TableOpt	72,X,2	Table_2004_API Table_1980_API
	Ethanol TableOpt	72,X,11	ABNT_NBR_5992 OIML R22

LIQUID SETUP Menu			
	GPA TP-27	72,X,3	GPATP27 Disables GPATP27 Enabled

ROC SETTINGS Menu			
General (1 logical, point type 91 & 137)	**Headings (Submenu Page 1)**	**TLP**	
	ROC Group	91,0,1	
	ROC Address	91,0,0	
	Station Name	91,0,2	
	IP Address	137,0,1	
	IP Port No.	137,0,4	
	Subnet mask	137,0,2	
	Headings (Submenu Page 1)	**TLP**	
	Gateway Address	137,0,3	

KEYPAD DISPLAY Menu			
Display Properties (1 logical, point type 62)	**Headings (Submenu Page 1)**	**TLP**	
	Display Presc.	62,0,151	Integer (1) Tenths (0.1) Hundredths (0.01)
	Display Mode	62,0,7	Black on White White on Black

COM PORT SETTINGS Menu			
COM Parameters (6 logicals, point type 95)	**Headings (Submenu Page 1)**	**TLP**	
	BaudRate Gen Used	95,X,1	BaudRate Gen 0 BaudRate Gen 1 BaudRate Gen 2 BaudRate Gen3
	STOP Bits	95,X,2	STOP Bit 1 STOP Bit 2
	DATA Bits	95,X,3	Data Bit 7 Data Bit 8
	Parity	95,X,4	None Odd Even
BaudRate Generator (1 logical, point type 91)	**Headings (Submenu Page 1)**	**TLP**	
	BaudRate Gen 0	91,0,31	
	BaudRate Gen 1	91,0,32	
	BaudRate Gen 2	91,0,33	
	BaudRate Gen 3	91,0,34	
Port Own. & Timeout (1 logical, point type 63)	**Headings (Submenu Page 1)**	**TLP**	
	Timeout Comport2	63,0,152	
	Timeout Comport3	63,0,153	
	Timeout Comport4	63,0,154	
	Timeout Comport5	63,0,155	
	Com Port 2	63,0,32	No App.

COM PORT SETTINGS Menu			
			Modbus DL6000 Data Log/Print
	Com Port 3	63,0,49	No App. Modbus DL6000 Data Log/Print
	Headings (Submenu Page 2)	**TLP**	
	Com Port 4	63,0,139	No App. Modbus DL6000 Data Log/Print
	Com Port 5	63,0,149	No App. Modbus DL6000 Data Log/Print

PID SETTINGS Menu			
Port Own. & Timeout (16 logicals, point type 110)	**Headings (Submenu Page 1)**	**TLP**	
	Prop. Gain (P)	110,X,15	
	Integ. Gain (I)	110,X,16	
	Deriv. Gain (D)	110,X,17	
	Output Type	110,X,5	Digital Vlv Discrete Analog
	Setpoint	110,X,10	
	Process Variable	110,X,8	
	Headings (Submenu Page 2)	**TLP**	
	DO Ctrl Upstr Pt	110,X,39	
	DO Ctrl Dnstr Pt	110,X,40	
	StdDigVlv Upstr Pt	110,X,55	
	StdDigVlv Dnstr Pt	110,X,56	
	Output Analog/HART	110,X,38	
	Scale Factor	110,X,18	
	Headings (Submenu Page 3)	**TLP**	
	Control Deadband	110,X,19	
	Output Low Limit	110,X,41	
	Output High Limit	110,X,42	

E.3.10 Generic TLP for Setup and Status

The keypad display program cannot display all the TLPs available in the preset. However, the program does provide a general TLP entry function you can use to access a TLP not usually available.

To access the Generic TLP entry screen:

Select **Setup/Configuration** from the Program Mode menu.

14/03/12 12:26:02	Clear Alarms
	Select Language
Choose an Option	Print Record
	Display Setting
(EXIT to Quit)	Calibration
(ENTER to Continue)	Current Status
	Setup/Configuration
	Diagnostics

Go to page **3** and select **Generic TLP Entry**:

14/03/12 12:26:02	
For traversing use	Generic TLP Entry
UP | DOWN	COM Port Settings
LEFT | RIGHT	Online Help
ENTER To Continue	
EXIT To Go Back	
EXIT To Quit	
	(Pg:3/3)

The Direct TLP Access menu displays.

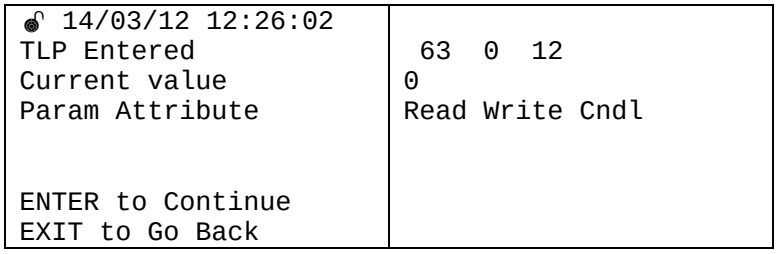
14/03/12 12:26:02	
Generic TLP entry	Direct TLP Access
COM port Settings	
PID Settings	
Online Help	
	(Pg:3/3)

Select **Direct TLP Access**. A screen displays that you use to define the TLP:

14/03/12 12:26:02	
Enter Type	0
Enter Logical	0
Enter Parameter	0
ENTER to Continue	UP | DOWN
EXIT to Quit	(0-9)

Press ⬇ to access each value. Once you define the TLP, press **Enter** to save your changes. The program validates the TLP you have entered. (Press **ALT+CLEAR** to exit the Direct TLP access screen.)

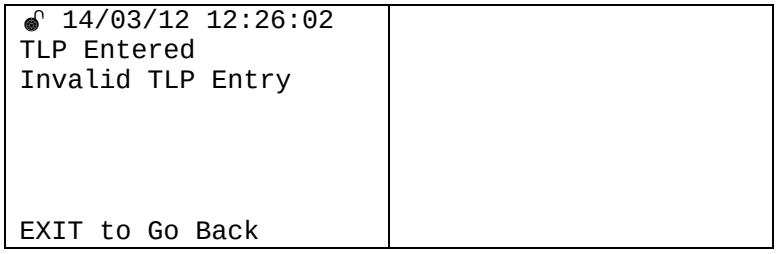
If the TLP is valid, the program displays the current value of the TLP and indicates the parameter's read/write attribute.



If the parameter's attribute is read/write or read/write conditional (**and** the W&M switch is unlocked), the *ENTER to Continue* message at the bottom of the screen indicates that you may enter a new value for the TLP.

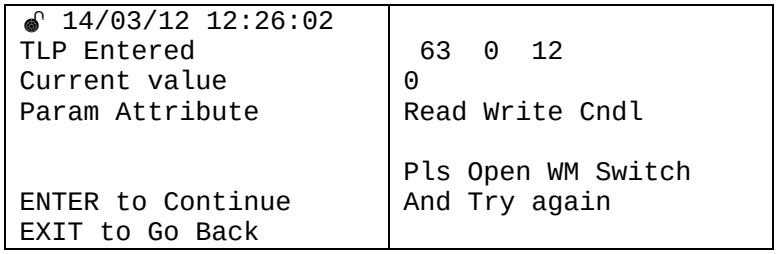
If the parameter is read-only, only the *EXIT to Go Back* message displays at the bottom of the screen.

If the TLP you specify is invalid, the program displays the following screen:



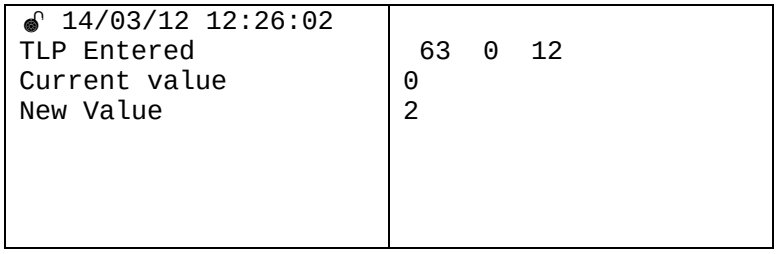
Press **ALT+CLEAR** to exit this screen and redisplay the parameter entry screen.

If the TLP is read/write or read/write conditional **and** the W&M switch is locked, the program displays the following message:



Press **ATL+CLEAR** to exit and return to the TLP entry screen. You can either enter a new value **or** open the W&M switch and press **ENTER** to try again.

Once the system updates the TLP with the new value, it displays the following screen:

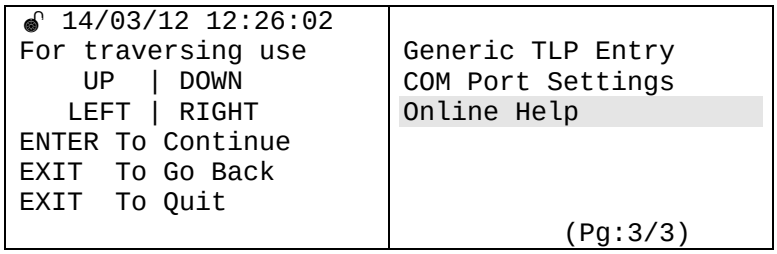


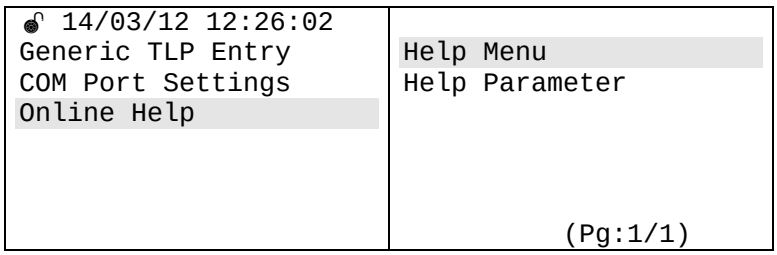
Press **EXIT** once to redisplay the TLP entry screen; press **EXIT** again to exit the menu.

E.3.11 Online Help

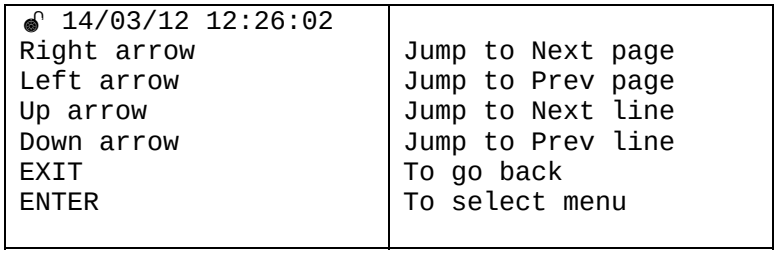
The keypad program online help is an option on the **last** page of the Setup/Configuration menu. These screens provide a quick on-demand reference of control keys and how to navigate through the menus and submenus.

Select **Online Help** to display two options.





Select **Help Menu** to display this screen:



This screen gives information about navigating between menus and submenus and about selecting menus and submenu

Select **Parameter Menu** to display this screen:

14/03/12 12:26:02	
Alt + 3	Jump to Next channel
Alt + 6	Jump to Prev channel
Alt + 4 in (A – Z)	Adds a space
Alt + 5 in (A –Z)	Adds a '#'
Alt + ENTER	Restore prev value
CLEAR	Clr param data

This screen gives information about all the control and entry key used to update parameter values, change logical, key to enter special characters, and restore previous value along with navigating information.

Note: To view additional navigation information, press ⬇.

14/03/12 12:26:02	
BKSP	Clr last Char entry
ENTER	To update value
Right arrow	Jump to Next page
Left arrow	Jump to Prev page
Up arrow	Move to Next Line
Down arrow	Move to Prev Line
EXIT	To go back

Press this key to…	Do this…
ALT + 3	Jump to next channel Use to select next available IO channel when defining IO.
ALT + 6	Jump to prev channel Use to select previous IO channgel when defining IO.
ALT + 4 in (A-Z)	Add a space during alphanumeric entry
ALT + ENTER	Restore previous value
CLEAR	Clr param data (clear the data entry for the parameter)
BKSP	Clr last char entry This key clears only the last character and not the entire value (use CLEAR for that).
ENTER	To update value
Right Arrow	Jump to next page (provided the number of pages is greater than 1)
Left Arrow	Jump to prev page (provided the number of pages is greater than 1)
Up Arrow	Move to Next Line
Down Arrow	Move to Prev Line

E.4 Calibration

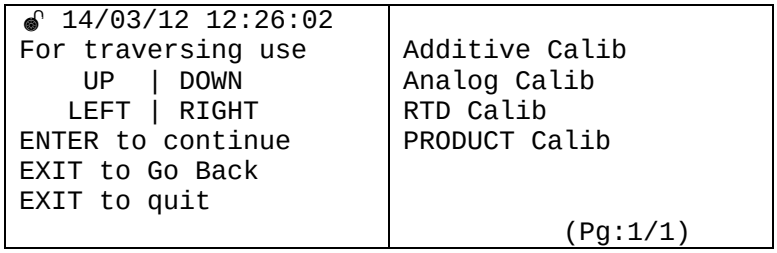
Warning **When performing calibrations, DO NOT remove a module after you start the calibration process. The system cannot automatically detect a module being removed and this may affect the results of your calibration.**

The keypad display program enables you to calibrate:

- Additive Meter
- Analog Input
- RTD
- Product Meter

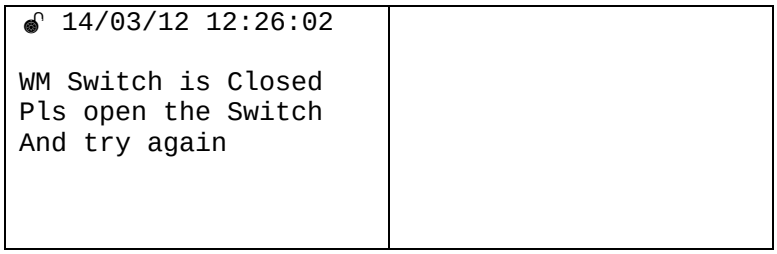
Caution **During calibration, the DL8000 times-out and reconnects if left idle for an extended period. In this case, you lose all calibration values and must reconnect to the DL8000 and restart the calibration. No error or warning message occurs.**

Each calibration process has its own menu. Select **Calibration** in program mode. The Calibration menu displays:



Select an option to display a calibration menu.

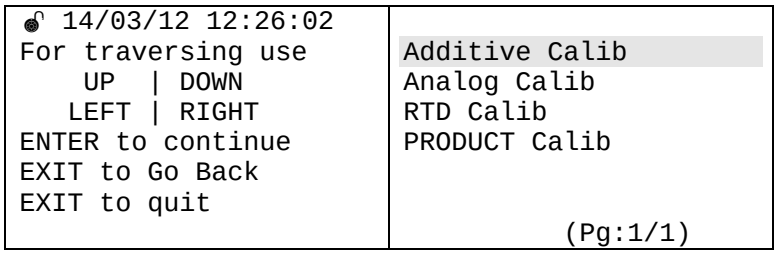
Note: If you select any calibration option, the DL8000 first checks the status of the W&M switch. If the switch is locked, the DL8000 prevents the calibration and displays a message:



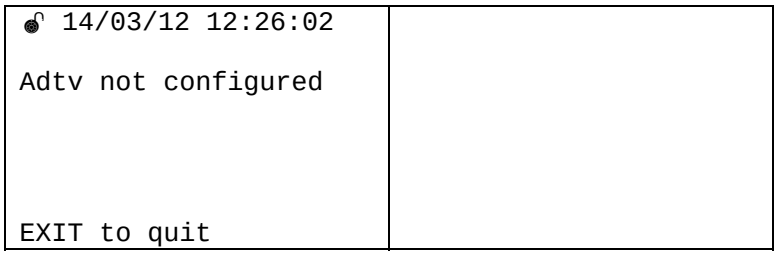
You must open the W&M switch in order to perform calibrations.

E.4.1 Calibrating Additive Meters

Select **Additive Calib** to start the additive calibration process.



If no additives are currently configured, the preset displays the following screen:



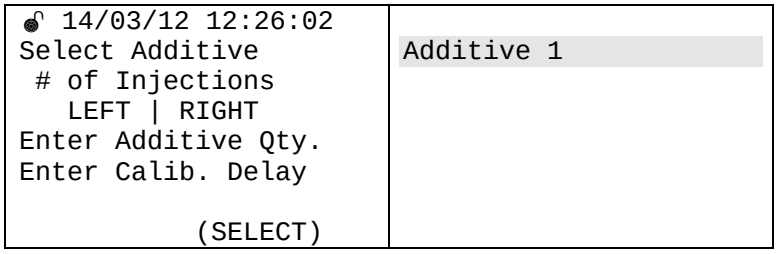
Press **EXIT** to quit; no calibration is possible.

In addition to the number of configured additives, the program can display the following error messages:

Error Message	Description
Adtv Prog. Not Available or Running	The additive program (#4) is not loaded or running.
Invalid Injection Method	The value of the injection method [67,X,1] is not **Control** (value 3)
K.F not configured	The Volume oper pulse/K –factor parameter [67,x,2] is set to **0**
M.F not configured	The Additive Meter Factor parameter [67,x,28] is set to **0**
Adtv not config	The parameter maximum additives parameter [63,0,100] is set to **0**

At the beginning of the calibration, the program checks for the "No additive configured" and "Additive user program not running" conditions. If you have forgotten to configure at least one additive or have forgotten to start the Additive program, you cannot perform additive calibration.

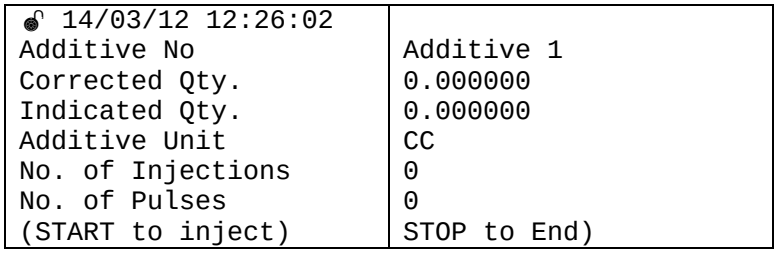
Assuming you have configured at least one additive and started the Additive program, the following screen displays:



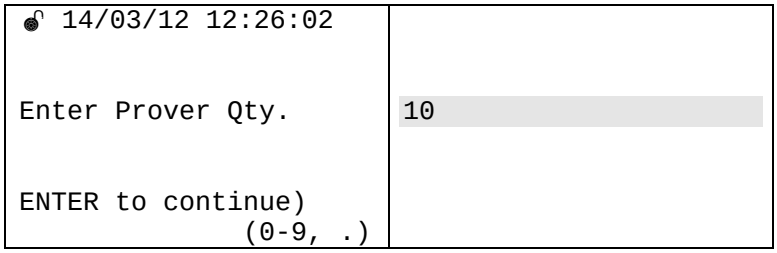
Press **SELECT** to choose an additive. The number of additives for selection depends on the value defined in the Maximum Additives parameter [63,0,100]. Once you select an additive, the system activates the respective pump and block valve for the additive.

After you select an additive, you must enter the required number of injections for calibration (defined in parameter [64,x,14]), the quantity of additive (parameter [64,x,20]), and the calibration delay (parameter [64,x,18]).

The preset validates the values you enter. If any errors exist, you cannot proceed with calibration. If no errors are present, the system displays the following loading screen:



Press **STOP** to end the calibration, or **START** to begin the calibration. After the program performs the defined number of injections, the program prompts you to enter a prover quantity:



Once you provide a prover volume and press **ENTER**, the system displays a meter factor:

14/03/12 12:26:02	
Current MF	1.000000
Corrected Qty	0.000000
Additive Units	CC
New MF	0.000000
Avg. MF	0.00000
(ENTER to update)	
(STOP to Reject)	

You can either accept the displayed current meter factor or press STOP to reject it. If you press **STOP**, the system rejects the new meter factor and retains the old meter factor. If you press **ENTER**, the system updates the Additive Meter Factor parameter [67,X,28] and displays the following screen:

14/03/12 12:26:02	
Enter Adtv M-Factor	1.1
(ENTER to accept)	
(0-9, .)	

Press **ENTER** to accept and update the additive's meter factor. The Additive Calibration screen displays:

14/03/12 12:26:02	
Select Additive	Additive 1
# of Injections	
LEFT | RIGHT	
Enter Additive Qty.	
Enter Calib. Delay	
(SELECT)	

Press **EXIT** to exit the additive calibration process and return to the Calibration menu:

14/03/12 12:26:02	
For traversing use	Additive Calib
UP | DOWN	Analog Calib
LEFT | RIGHT	RTD Calib
ENTER to continue	PRODUCT Calib
EXIT to Go Back	
EXIT to quit	(Pg:1/1)

E.4.2 Calibrating Analog Input

Note: The preset must have an installed AI module to calibrate AI. If you attempt an AI calibration without a module, the system displays the message *NO AI Card in system* on the left-hand screen.

To calibrate analog inputs, select the **Analog Calib** option on the Calibration menu screen:

14/03/12 12:26:02 For traversing use UP | DOWN LEFT | RIGHT ENTER to continue EXIT to Go Back EXIT to quit	Additive Calib Analog Calib RTD Calib PRODUCT Calib (Pg:1/1)

The system then displays all available analog inputs. Select an analog input channel for calibration:

14/03/12 12:26:02 Sel Analog Ch Sel No of Mid pt (SELECT)	AI ch 1

Then choose the number of mid-points. Press **SELECT** to see the available options (zero, 1, 2, and 3):

14/03/12 12:26:02 Sel Analog Ch Sel No of Mid pt (SELECT)	AI ch 1 Zero

Press **ENTER** to continue the calibration process and display the next screen, which shows the live value from the analog source:

14/03/12 12:26:02	Live Dead
Enter ZERO EU	-0.09100 0
Enter SPAN EU	
(ENTER to update)	
(STOP to End)	(0-9, .)

Next to the live value is the corresponding "dead" (or expected) value, which you can change.

Note: Refer to the wiring diagram which connects the AI module to an external AO.

If you have selected additional mid set points, repeat the process of defining the expected values.

14/03/12 12:26:02	Live Dead
Enter ZERO EU	-0.09100 0
Enter SPAN EU	99.857282 100
(ENTER to update)	
(STOP to End)	(0-9, .)

Once you complete the process of defining all calibration points, press **ENTER**. The system then updates all affected TLPs (zero=103,X,13; span=103,X,17; Mid1=103,X,14; Mid2=103,X,15; and Mid3=103,X,16) and begins the calibration process.

Note: If the calibration aborts for any reason, the system returns these TLPs to their previous values.

Aborting an AI Calibration

At any time when a calibration is in progress you can press **STOP** to abort the calibration. The display shows a *Calibration aborted* message for two seconds and then redisplays the list of analog inputs which you can use to start another calibration sequence.

Point Fail Alarms

When you select an AI analog channel for calibration **or** when calibration is in progress, the program checks for a point failure.

Note: During calibration the program **only** performs a point fail check.

If a point fail alarm occurs, the preset displays a *Point Fail Alarm* message and prompts you to exit the calibration. When you press **EXIT**, the display shows the screen to select an analog channel, allowing you to select begin the calibration process again.

Once the calibration completes, the program displays a summary screen. You can then accept or reject the new calibration value(s):

14/03/12 12:26:02	Live Dead
Enter ZERO EU	-0.09100 0
Enter SPAN EU	99.857282 100
(ENTER to accept)	(STOP to Reject)

When you press **ENTER**, the program updates the values and displays a screen indicating the successful completion of the calibration process.

14/03/12 12:26:02	
Calibration Done	

The program then redisplays the channel selection screen. You can begin another AI calibration or exit the AI calibration menu.

If you press **STOP**, the program restores the old calibration values.

Affected Point Types

The program affects the following point types during calibration:

- ZERO EU [103,X,13]
- MID point 1 [103,X,14]
- MID point 2 [103,X,15]
- MID point 3 [103 X,16]
- SPAN EU [103,X,17]
- Set value [103,X,19]
- Calibration mode [103,X,34]
- Calibration type [103,X,35]

E.4.3 Calibrating RTDs

Note: The preset must have an installed RTD module to calibrate RTDs. If you attempt an RTD calibration without a module, the system displays the message *NO RTD Card in system* on the left-hand screen.

To calibrate RTDs, select the **RTD Calib** option on the Calibration menu screen:

14/03/12 12:26:02	
For traversing use	Additive Calib
UP | DOWN	Analog Calib
LEFT | RIGHT	RTD Calib
ENTER to continue	PRODUCT Calib
EXIT to Go Back	
EXIT to quit	
	(Pg:1/1)

The preset displays all available RTD channels. In sequence, you select the appropriate RTD channel, number of mid-points, and the units for calibration:

14/03/12 12:26:02	
Sel RTD Ch	RTD Ch 1
Sel No of Mid pt	
Sel Unit	
Zero UE Value	
Span EU Value	
(SELECT)	

Once you select an RTD channel, the program shows the existing zero and span values of the selected channel. You then enter the number of mid-points and the units:

14/03/12 12:26:02	
Sel RTD Ch	RTD Ch 1
Sel No of Mid pt	Zero
Sel Unit	
Zero UE Value	100.000000
Span EU Value	229.000000
(SELECT)	

14/03/12 12:26:02	
Sel RTD Ch	RTD Ch 1
Sel No of Mid pt	Zero
Sel Unit	Ohms
Zero UE Value	100.000000
Span EU Value	229.000000
(SELECT)	Point Fail Alarm

Note: If a point fail alarm occurs for the selected channel, the system displays a Point Fail alarm message at the bottom of the right-hand screen (as shown above). This alarm does not stop the calibration; it is provided for information only. During calibration the program clears the message if the condition does not exist.

After you provide all the parameters required for calibration press **ENTER** to continue. The program then displays the live value from an

external source with a corresponding “dead” (expected) value you can change.

14/03/12 12:26:02	Live Dead
Enter ZERO EU	80.3000003 80.5
Enter SPAN EU	
(ENTER to update)	
(STOP to End)	(0-9, .)

Press **ENTER** to update the value. You then enter a span value:

14/03/12 12:26:02	Live Dead
Enter ZERO EU	80.3000003 80.5
Enter SPAN EU	229.000000 228.99
(ENTER to update)	
(STOP to End)	(0-9, .)

If you need mid-points for calibration, enter those next.

The program checks all values you enter. If any value is not within accepted ranges, the program displays the error message *InvdEntry!ReEnter*:

14/03/12 12:26:02	Live Dead
Enter ZERO EU	80.3000003 80.5
Enter SPAN EU	229.000000 228.99
(ENTER to update)	InvdEntry!ReEnter ←
(STOP to End)	(0-9, .)

You must re-enter those values in order to proceed.

Valid ranges are:

RTD unit	Minimum Range	Maximum Range
Deg F	-58.0	662.0
Deg C	-50.0	350.0
Deg K	223.15	623.15
Deg R	401.67	1121.67
OHM	80.31	229.72

The program performs the following range checks:

- **Set Zero**: Entered value ≥ Minimum Range **AND** Entered value ≤ Maximum Range
- **Set Span**: Entered value > Set Zero **AND** Entered value ≤ Maximum Range
- **Set Mid-points** (1, 2, 3): Entered value ≥ Set Zero **AND** Entered value ≤ Set Span

Aborting an RTD Calibration

At any time when a calibration is in progress you can press **STOP** to abort the calibration. The display shows a *Calibration aborted* message for two seconds and then redisplays the list of RTD channels which you can use to start another calibration sequence.

After completing these steps, press **ENTER** to initiate the calibration. When the calibration completes, the program displays a summary screen. You can then accept or reject the new calibration value(s):

14/03/12 12:26:02	Live Dead
Enter ZERO EU	80.3000003 80.5
Enter SPAN EU	229.000000 228.99
(ENTER to accept)	(STOP to Reject)

When you press **ENTER**, the program updates the values and displays a screen indicating the successful completion of the calibration process.

14/03/12 12:26:02	
Calibration Done	

The program then redisplays the channel selection screen. You can begin another RTD calibration or exit the RTD calibration screen.

If you press **STOP**, the program restores the old calibration values.

The program checks internally to make sure the values for zero and span update correctly. If the values do not match, the system display a *Calibration Failed* message:

14/03/12 12:26:02 Calibration Failed	

Affected Point Types

The program affects the following point types during calibration:

- ZERO EU [104,X,14]
- MID point 1 [106,X,15]
- MID point 2 [106,X,16]
- MID point 3 [106 X,17]
- SPAN EU [103,X,18]
- Set value [103,X,20]
- Calibration mode [103,X,35]
- Calibration type [106,X,36]
- Units [106,X,37]

Note: The system only checks the point fail alarm during an RTD calibration.

E.4.4 Calibrating Product Meters

Unlike the DanLoad 6000 (which required manual calibration of product meters), the DL8000 performs most of the calibration steps automatically. When appropriate, the program prompts you for required data. You can enter this information from the keypad display.

The DL8000 provides two parameter-controlled options for selecting the meter factor [69,X,74] :

- Single MF (0)
- Multiple MF (Meter factor curve) (1)

Single MF

Regardless of the available number of flow rates, the system supports only **one** applicable MF. For example, if the preset has two flow rate set points (FR1 for low flow rate and FR2 for high flow rate), the system supports a **single** MF for both flow rate 1 and 2.

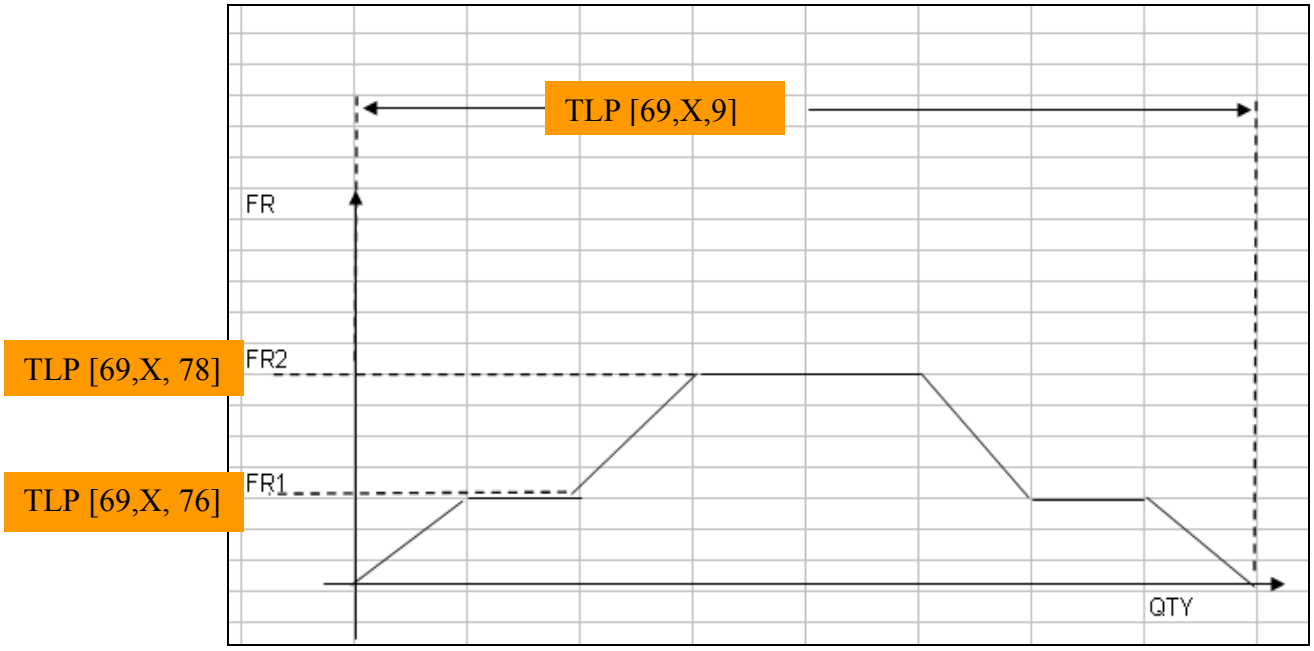


Figure E-6. Multiple Flow Rates with a Single Meter Factor

Multiple MF Each flow rate in the system has a **separate** MF. For example, if the preset has two flow rate set points (FR1 for low flow rate and FR2 for high flow rate), the system supports a separate MF for flow rate 1 (MF 1) and for flow rate 2 (MF 2).

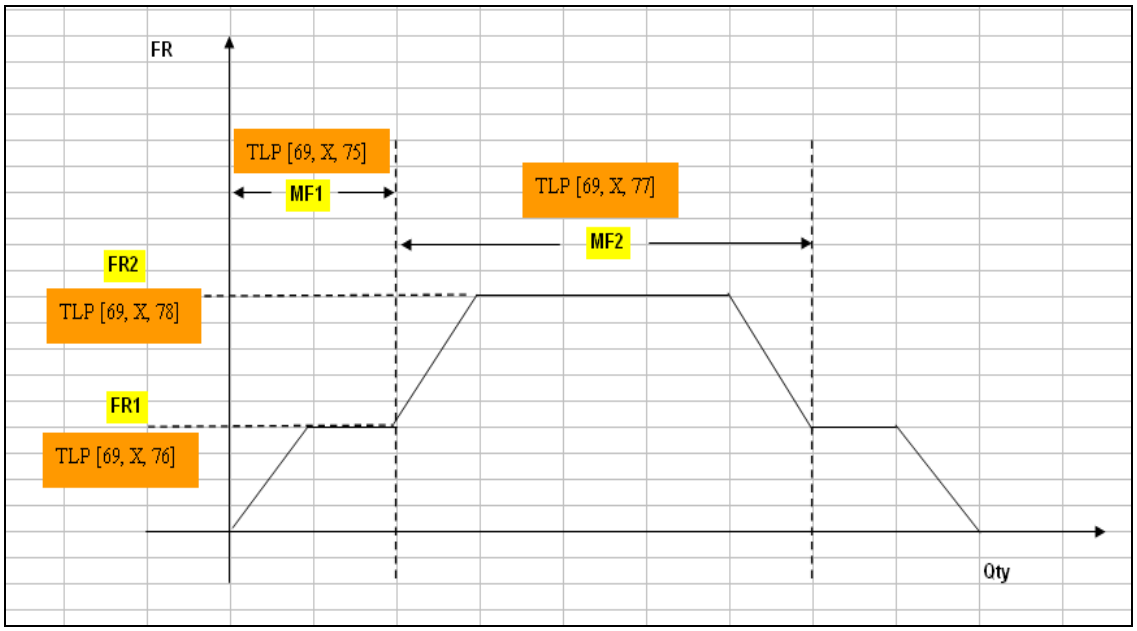


Figure E-7. Multiple Flow Rates with Multiple Meter Factors

Note: Whether you select single and multiple meter factors changes the process of product calibration slightly. Differences, as appropriate, are noted.

Select **PRODUCT Calib** to start the product meter calibration process.

14/03/12 12:26:02	
For traversing use	Additive Calib
UP | DOWN	Analog Calib
LEFT | RIGHT	RTD Calib
ENTER to continue	PRODUCT Calib
EXIT to Go Back	
EXIT to quit	
	(Pg:1/1)

The system then displays a Prover Selection menu, showing the supported proving methods.

Note: The menu displays Can Proving, which is the **only** proving method currently supported.

14/03/12 12:26:02	
Additive Calib	Can Prover
Analog Calib	
RTD Calib	
PRODUCT Calib.	
	Pg:1/1)

Press **ENTER** to continue or **EXIT** to halt the calibration process and return to the Calibration menu.

You must check the following preconditions before proceeding:

- Check Transaction status
- Check WM status

Check Transaction Status

Check the transaction status first from the Status Flag [63,0,119]. If you select product calibration and a transaction has not ended, the system displays the following message:

14/03/12 12:26:02	Transaction Inprog
EXIT to Quit	Stop To End Trans

You can either press **EXIT** to quit product calibration or **STOP** to end the current transaction.

If a transaction is in progress and you press **STOP**, the transaction ends and batching status moves to 1 (Select Recipe).

If you have enabled the automatic selection of recipes (parameter 64,0,5), this parameter **also disables** automatic recipe selection. This option, if not disabled, prevents the transaction from ending.

Note: Selecting Product Calibration disables the automatic recipe selection feature. The program does not automatically restore this feature. You must manually reset it if required.

Check Weights & Measures Switch

Once the transaction has ended and batching status [63,0,9] is Select Recipe (1), the system then checks the state of the Weights & Measures switch [62,0,148]. If the switch is closed (status is 1), the following message displays:

14/03/12 12:26:02 EXIT to Quit	WM Switch is Closed Pls open the Switch And press ENTER

This screen displays until you either open the W&M switch **or** exit product calibration.

Select Delivery Type

If the W&M switch is open, the process moves to the selection of the product delivery type [63,0,29].

14/03/12 12:26:02 Sel Delivery Type ENTER to Continue Exit to Quit (SELECT)	 Gross

Press **SELECT** to choose a preset delivery type (Gross, Standard, or Mass) and then press **ENTER** to move to the next screen in the process. (Press **EXIT** to redisplay the Prover Selection screen.)

Select Product

After selecting a delivery type, you then select the product (or component) to be calibrated. The available components are defined in the Number of Components in System parameter [63,0,21].

14/03/12 12:26:02 Select Component ENTER to Continue Exit to Go Back (SELECT)	 Component 1

Press **SELECT** to choose a component and then press **ENTER** to move to the next screen in the process. (Press **EXIT** to redisplay the Delivery Type selection screen.)

Select Meter

After selecting a component, you then select the meter for the component. The available meters are defined in the Number of Meters parameter [63,0,20].

14/03/12 12:26:02 Component Select Meter ENTER to Continue EXIT to Go Back (SELECT)	 Component 1 Meter 1

Press **SELECT** to choose a meter for the displayed component and then press **ENTER** to move to the next screen in the process. (Press **EXIT** to redisplay the Component selection screen.)

Display MF/K-factor

After you select a meter and press **ENTER**, the system displays the meter factor/K-factor option for the selected meter.

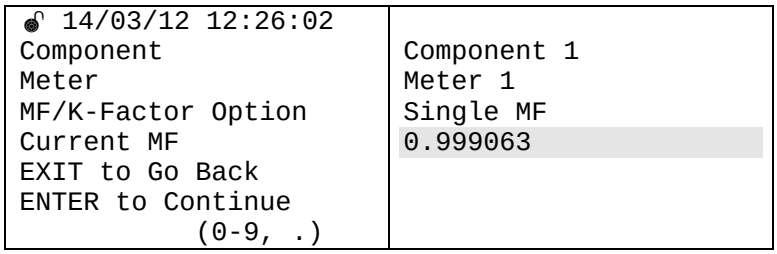
14/03/12 12:26:02 Component Meter MF/K-Factor Option ENTER to Continue EXIT to Go Back)	 Component 1 Meter 1 Single MF

14/03/12 12:26:02 Component Meter MF/K-Factor Option ENTER to Continue EXIT to Go Back)	 Component 1 Meter 1 MF Curve

Note: The meter factor/K-factor option shown on this screen is **display only**; you **cannot** change the option using this screen. To change the option, you must exit product calibration and select a new

component-related option using either the Setup/Configuration option on the keypad display or ROCLINK 800.

If you are satisfied with the displayed meter factor/K-factor option, press **ENTER** to continue. The system then displays the current value for the meter factor:

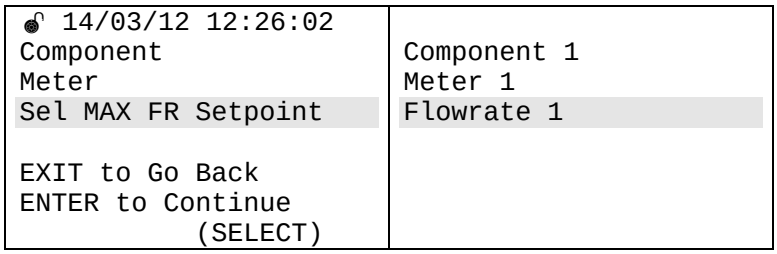


Note: This screen **does not** display if the MF/K-factor Option is **MF Curve**.

To continue the process, press **ENTER**. The system prompts you to define a maximum number of flow rate set points. (Press **EXIT** to redisplay the Component selection screen.)

Select Max Flow Rate Setpoint (Single Meter)

After you accept the current meter factor, you define the maximum number of flow rate set points using the following screen:



Press **SELECT** to define the number of flow rate set points. This applies to **all** components in the system. You must select at least 1 set point to a maximum 12 set points. The system updates the No of Points of Meter Factor Linearization parameter [63,0,109] according to your choice. For example, if you select Flowrate 4, the system sets parameter 63,0,109 to **4** and the highest flow rate set point is now 4.

To continue the process, press **ENTER**. The system prompts you to define the values for each set point. (Press **EXIT** to redisplay the Max FR Set points screen.)

Select Flow Point Values (Single MF)

After you define the maximum number of set points, you then need to enter flow rates for each set point using the following screen:

Note: This sequence shows the screens for a **single** meter factor.

14/03/12 12:26:02	
Flowrate 1	0.000000
Flowrate 2	0.000000
Flowrate 3	0.000000
Flowrate 4	0.000000
UP | DOWN	
ENTER to Continue	

The system can display a maximum of four flow rates on one page. If you have defined more than four flow rates, they appear on the next and subsequent pages (for a maximum of three pages).

Use the ⬇ and ⬆ keys to move between flow rates, changing the values as necessary. For this example, we defined four flowrates:

14/03/12 12:26:02	
Flowrate 1	100.000000
Flowrate 2	200.000000
Flowrate 3	300.000000
Flowrate 4	400.000000
UP | DOWN	
ENTER to Continue	

Once you define the values, press **ENTER** to continue to the next screen. (Press **EXIT** to redisplay the Max FR Set points screen.)

Note: When you press **ENTER**, the system verifies that all flow rates are in **ascending** order (that is, flow rate 2 is greater than flow rate 1, flow rate 3 is greater than flow rate 2, and so on) and that no flow rate is zero. If the system detects an error, it displays the message *Flowrate Cfg Error* .

After you define the flow rate set points, press **ENTER** to continue. The preset adds the flow rates to the appropriate TLPs ([69,X,76] to [69,X,98]) and displays a screen summarizing the selected configuration:

14/03/12 12:26:02	
Component	Component 1
Meter	Meter 1
Sel MAX FR Setpoint	Flowrate 5
Max Flowrate	500.000000
Current MF	0.999063
ENTER to Continue	
EXIT To Go Back	

Press **EXIT** to redisplay the flowrate entry screen.

Select Flow Point Values (Multiple MFs)

When calibrating with multiple meter factors, it is essential that you proceed in steps, first calibrating product at a low flow rate and then proceeding to progressively higher flow rates. Calibrating the product at low flow rates ensures that inaccuracies at lower flow rates do not get added when calibrating at a higher flow rate.

Note: This sequence shows the screens for **multiple** meter factors.

First, select the number of flow rate set points (a minimum of 1 to a maximum of 12) with which to calibrate the product. The system updates the No of Points of Meter Factor Linearization parameter [63,0,109] based on the number of set points you define.

For example, if you define four set points, the system sets the parameter [63,0,109] to **4**, which also becomes the highest flow rate set point. (Flow rate 1 is the lowest and flow rate 4 is the highest.) The number of flow rate set points you define applies to **all** components in the system.

14/03/12 12:26:02	
Component	Component 1
Meter	Meter 1
Sel MAX FR Setpoint	Flowrate 4
EXIT to Go Back	
ENTER to Continue	
(SELECT)	

Press **ENTER** to continue (or press **EXIT** to return to the MF/K-factor option screen.) The system then shows a screen summarizing the flow rate and mater factor associated with the selected set points:

14/03/12 12:26:02	
Component	Component 1
Meter	Meter 1
Flowrate 5	500
Current MF 5	1.000000
UP | DOWN	
ENTER to Continue	

Press **ENTER** to continue (or press **EXIT** to redisplay the maximum flow rate set point screen). The system prompts you to accept or edit the displayed values. For this screen, you can edit the flow rate and the current meter factor. The component and meter values cannot be changed.

Press ⬆ and ⬇ to move between the flow rate and meter factor values. If you are satisfied with the displayed values, press **ENTER** to move to the next screen.

After you press **ENTER**, the system verifies that all flow rates are still in ascending order (that is, flow rate 1 < flow rate 2 < flow rate 3 < flow rate 4) and that no flow rate is less than zero.

If the system finds any problems, displays an error message:

14/03/12 12:26:02	
EXIT To Go Back	Flowrate Cfg Error

To resolve any configuration errors, press **EXIT** to return to the previous screen and re-define the flow rates.

When the system verifies the configuration, it updates all values and displays a summary screen:

14/03/12 12:26:02	
Component	Component 1
Meter	Meter 1
Sel MAX FR SetPoint	Flowrate 5
Current MF	500.000000
ENTER To Continue	1.000000
EXIT To Go Back	

To change any value, press **EXIT** to redisplay the set flow rate set points screen.

If you are satisfied with the summary display of values, press **ENTER**. The preset configures recipe 1 using the identified components 100% of the recipe. For example, if you select component 1, the system configures recipe 1 as:

- CMP 1 = 100% [68,0,1]
- CMP 2 = 0 [68,0,2]
- CMP3 = 0 [68,0,3]
- CMP4 = 0 [68,0,4]
- Seq. or Lo proportion = 1 [68,0,17]

Note: The Seq. or Lo proportion depends on the number of the selected component. If you select component 2, the Seq. or Lo Proportion value becomes **2**.

Additionally, the system:

- Sets Unit Type [63,0,12] as 0 (“Seq. Auto”)
- Sets No. of batches per transaction [63,0,126] to 0 (zero)
- Sets Disable the Flush [68,0,5] to 0
- Sets No. of additives [63,0,100] to 0
- Sets No. of data items [63,0,186] to 0
- Sets the number of info parameters [63,0,228] to 0
- Sets the number of data items [63,0,186] to 0

- Disables Auto select recipe [64,0,5] (This occurs as soon as you select the Product Calibration option)

Switching from Program Mode to Loading Mode

After you complete the configuration, the preset automatically switches from program mode to loading mode. In loading mode, the preset automatically selects recipe 1 and then displays the Enter Preset Quantity screen:

14/02/12 13:58:59 Enter Preset Quantity ENTER to Continue EXIT To Go Back	Recipe 1 [1000] Gal

Enter a preset quantity and press **ENTER.** The Loading screen displays. As with normal batching, press **START** to start the batch.

14/02/12 13:58:59 Loaded: 0 Gal (Start to Load)	Recipe #1 Corrected: 60 deg F Temp: 20 Vol Units: Gal Gross: 0 Net: 0 (STOP to abort)

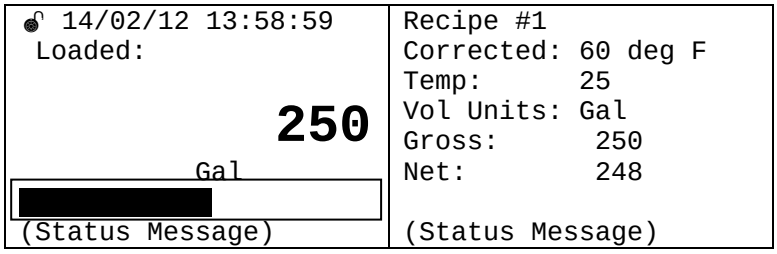
Press **STOP** to abort the loading process and redisplay the Enter Preset Quantity screen.

If you enter an invalid value on the Enter Present Quantity screen, the system displays an error message:

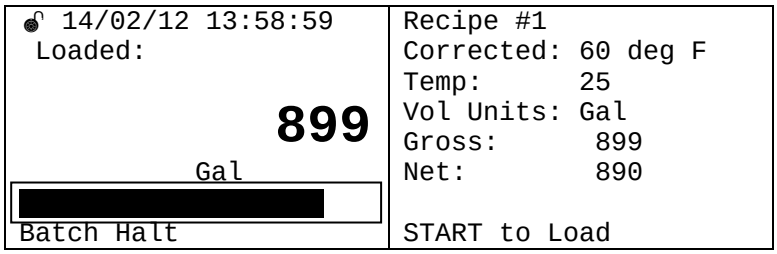
14/03/12 12:26:02 Invalid Preset… (Info Message)	 (Press CLEAR)

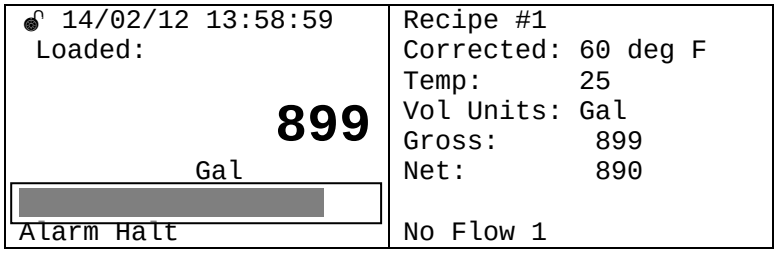
Press **CLEAR** to redisplay the Enter Preset Quantity screen.

If the preset quantity is valid, the following screen displays after you press **START**:



If the batch stops ("halts") during loading due either to user intervention or an alarm halt, one of the following screens displays:





Note: If an alarm occurs during a prover batch, you **must reset** the alarm. Until you resolve the alarm condition, you cannot use the keypad to switch to program mode.

Switching from Loading Mode to Program Mode

When batch loading completes successfully, the system automatically shifts to program mode [63,0,9].

If an alarm halt or a user-initiated halt (from pressing **STOP**) occurs during loading, once the batch ends the system automatically enters program mode.

At the initiation of program mode the system checks for the following conditions to ensure the batch is valid for proving:

SL. No.	Condition to check valid batch	Action taken
1	Any flow alarm or fallback alarm during batch loading (see note below)	Warning displays before you enter a prover volume. If you press **ENTER**, the system displays a screen on which you enter the prover

SL. No.	Condition to check valid batch	Action taken
		volume. System displays a screen with updated information on Batch loaded Qty and Current MF and prompts you to enter a prover volume.
2	User halt or alarm halt (except any flow alarm or fallback alarm)	System prompts you to enter a prover volume for whatever delivery has been made. System displays a screen with updated information on Batch loaded Qty and Current MF and prompts you to enter a prover volume.
3	Batch ends normally (no flow alarm or fallbacks occurred during loading)	System displays a screen with updated information on Batch loaded Qty and Current MF and prompts you to enter a prover volume.

Note: The system monitors fallback throughout the product calibration proving batch. The keypad display program sets the fallback flag [62,0,180] in case of fallback during delivery. For regular batching this flag does not set or reset.

The system displays this screen, which you use to enter a prover volume. When you press **ENTER**, the system calculates a new meter factor. You then can accept or reject the new meter factor.

```
14/03/12 12:26:02          Component 1
Component                  Meter 1
Meter                      1.000000
Current MF                 11.670000
Batch loaded Qty           0.000000
Enter Prover Vol
ENTER to Continue
          (0-9, .)
```

```
14/03/12 12:26:02          Component 1
Component                  Meter 1
Meter                      1.000000
Current MF                 1.000600
New MF
Enter To Update
STOP to Reject
EXIT To Go Back
```

Press **ENTER** to accept the new meter factor. Based on the MF/K-factor option, the system determines the new meter factor using the equation:

$$\text{New Meter Factor} = \frac{\text{User-entered prover volume}}{\text{Quantity delivered by preset}} \times \text{Existing (old) Meter Factor}$$

If you enter a prover volume of zero, the system retains the old meter factor.

Single MF/K-factor Option

When you press **ENTER**, the system updates the meter factor parameter [69,X,9] with the new value and displays a screen allowing you to rerun the batch.

If you press **STOP**, the system retains the current meter factor parameter value and displays a screen allowing you to rerun the batch.

If you press **EXIT**, the system redisplays the prover volume entry screen, which you can use to re-enter the prover volume.

Multiple MF/K-factor Option

When you press **ENTER**, the system updates the meter factor using the new value.

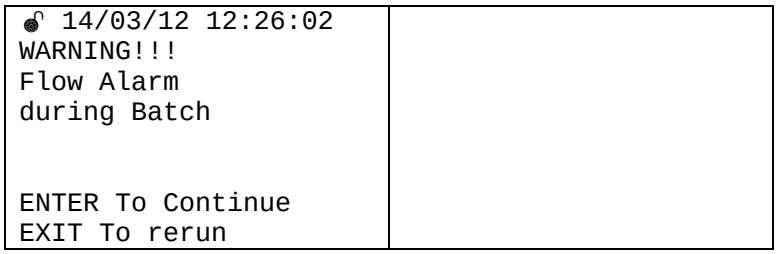
Depending upon the selected flow rate set point, the system updates the meter factor to the appropriate TLP (that is, if 1 is the selected flow rate set point, the system updates the parameter Meter Factor 1 [69,x,75]. Similarly, if the MAX FR SP is 4, the system updates the parameter Meter Factor 4 [69,X,81] and then displays a screen allowing you to rerun the batch.

If you press **STOP**, the system retains the current meter factor value (Meter Factor, [69,X,81]), and then displays a screen allowing you to rerun the batch.

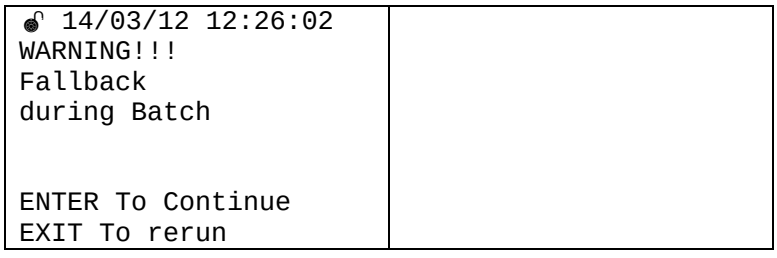
If you press **EXIT**, the system redisplays the prover volume entry screen which you can use to re-enter the prover volume.

Flow Alarm or Fallback Alarm During Proving Batch Loading

If a flow alarm or fallback alarm occurs during batch delivery, the system does not prompt you to enter a prover volume. Instead, the system displays a warning screen showing the particular error:



Note: Flow alarms include Low Flow, High Flow, No Flow, Unauthorized Flow, and Unable to Close Valve.

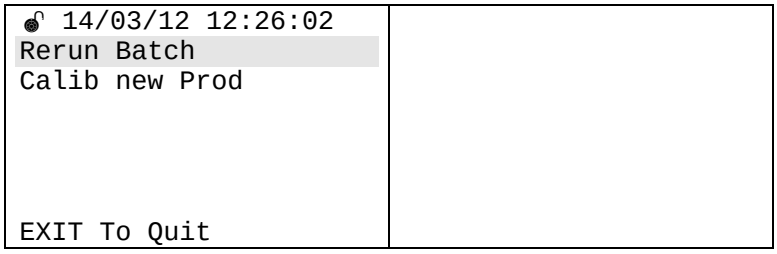


Press **EXIT** to rerun the batch. The system displays the Rerun option screen, displaying rerun options (based on the selected MF/K-factor option).

Note: The system does not generate an alarm for a fallback condition. (This is a feature of the preset.) Instead, the system monitors for fallback throughout the proving batch, and informs you of the fallback **before** you enter a prover volume and calculate a new meter factor.

Rerun or Exit

The system displays this screen at the end of the prover run. Use it to rerun the batch and recalculate the meter factor.

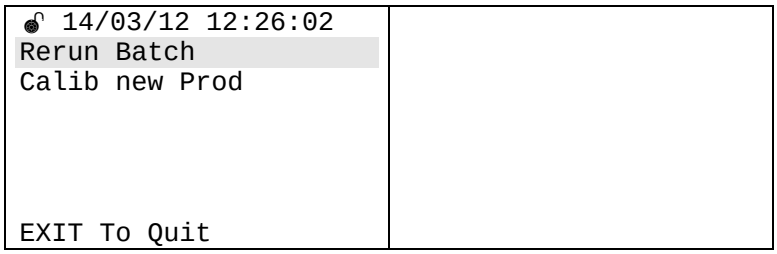


This screen enables you to select a batch rerun option based on the MF/K-factor option you previously chose:

- **Option 1**
  Run next batch with same settings to fine-tune the meter factor (return to loading mode)
- **Option 2**
  Calibrate (for the same product) another flow rate set point. This is required with the multiple MF option, since you are calculating higher set points step-by-step for the selected product.
- **Option 3**
  Calibrate another component.
- **Option 4**
  Exit the calibration process (located on the last line of the left-hand side screen).

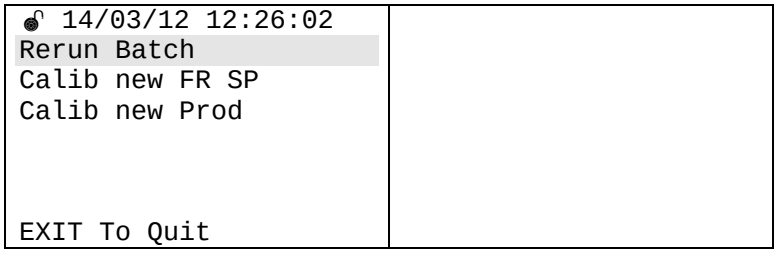
Single MF/K-factor Option

If you are using the single MF/K-factor option, this screen provides the following options:

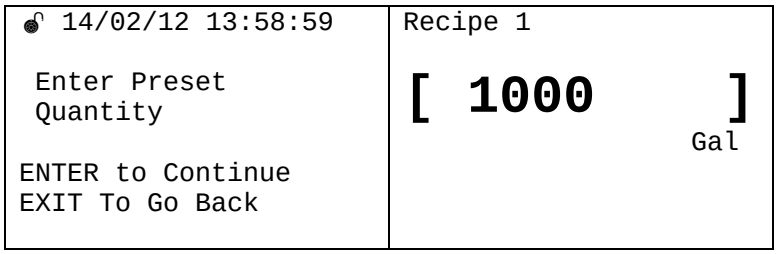


Multiple MF/K-factor Option

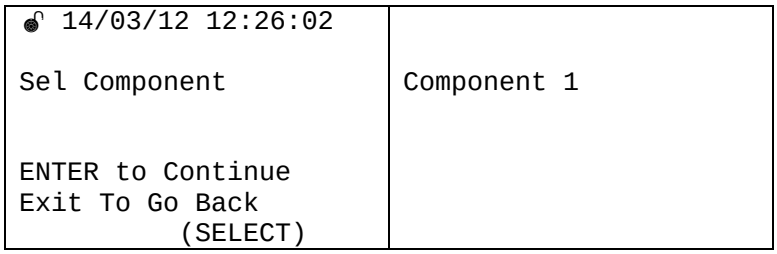
If you are using the multiple MF/K-factors option, this screen provides the following options:



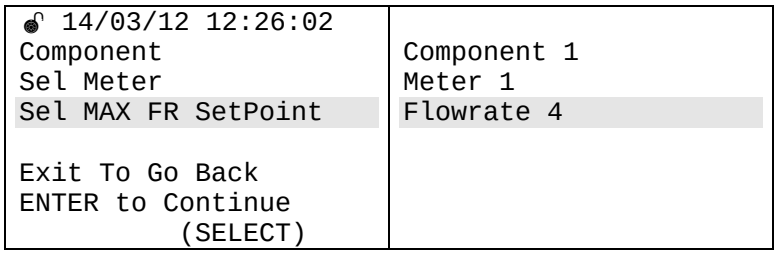
Select **Rerun Batch**. The system redisplays the loading screen:



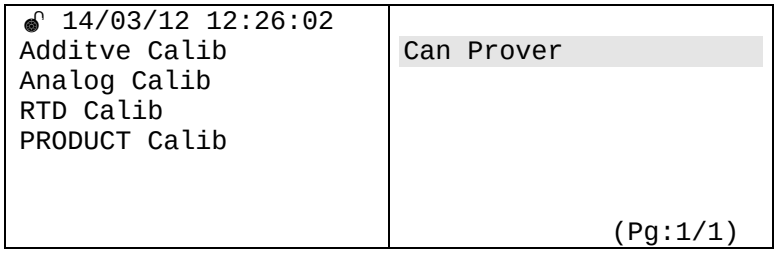
If you select **Calib new Prod**, the system displays a component selection screen:



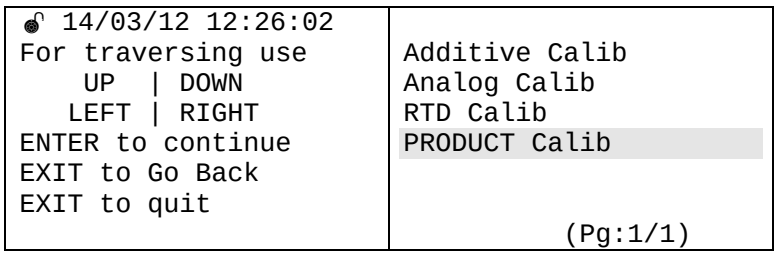
If you select **Calib new FR SP**, the system displays the following component selection screen:



Press **EXIT** to end the product calibration process and display the following screen:



Press **EXIT** again to display the Calibration menu screen:



E.5 Diagnostics

Warning **When performing diagnostic procedures, DO NOT remove a module after you start a procedure. The system cannot automatically detect a module being removed and this may affect the results of your tests.**

Use this menu option to test various hardware modules and to resolve error conditions. Select **Diagnostics** on the Program menu screen to display a submenu of modules to diagnose:

14/02/12 13:58:59 Choose an Option (EXIT to Quit) (ENTER to Continue)	Clear Alarms Select Language Print Record Display Setting Calibration Current Status Setup/Configuration Diagnostics

14/03/12 12:26:02 For traversing use UP | DOWN LEFT | RIGHT ENTER to continue EXIT to Go Back EXIT to quit	 DO DI AO AI ACIO RS232 (Pg:1/2)

14/03/12 12:26:02 For traversing use UP | DOWN LEFT | RIGHT ENTER to continue EXIT to Go Back EXIT to quit	 RS485 (Pg:2/2)

Note: When diagnosing IO modules, you can either use an external signal source or use DL8000 modules (for example, for DI diagnostics, you can use a DO module to generate signals).

E.5.1 Diagnosing Digital Outputs (DO)

Note: The preset must have an installed DO module to diagnose the DO. If no DO module is present, the system displays an *No DO Card in system* error message.

Hardware/ Wiring You can connect a DI channel with the DO channel to be tested, or connect to an external source. See *Figure E–8*.

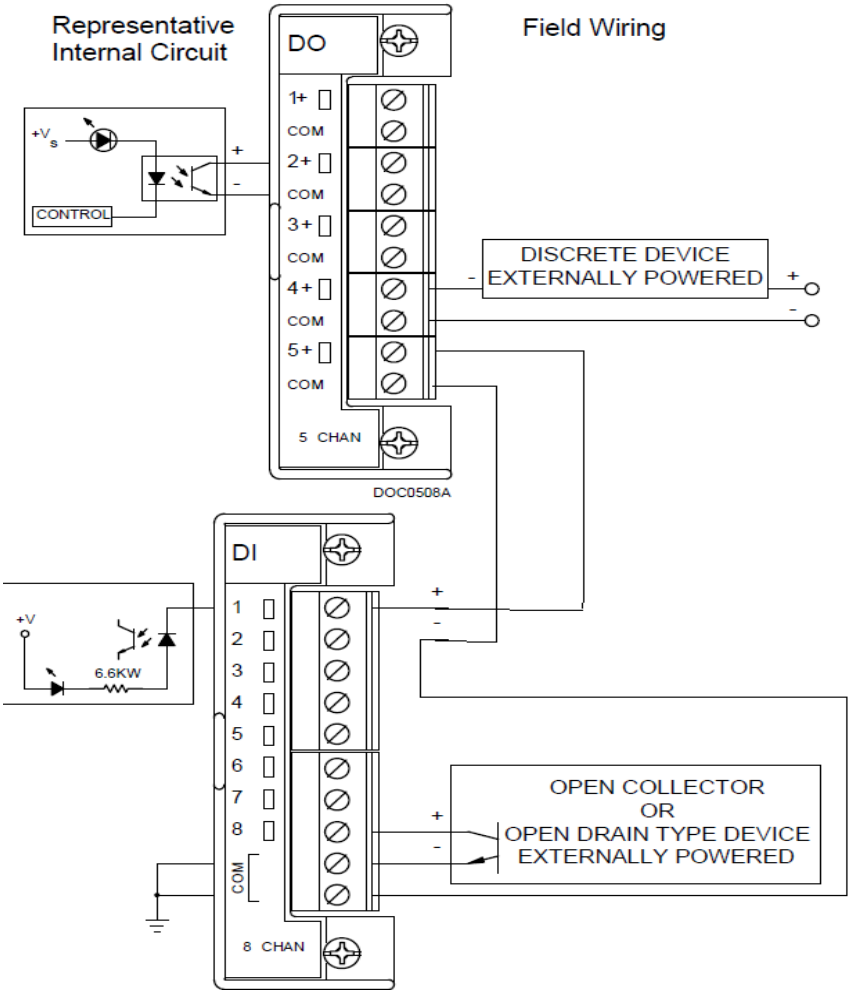


Figure E-8. DO Module Field Wiring

Select **DO** to perform DO diagnostics:

14/03/12 12:26:02 For traversing use UP | DOWN LEFT | RIGHT ENTER to continue EXIT to Go Back EXIT to quit	DO DI AO AI ACIO RS232 (Pg:1/2)

The system displays a channel selection screen.

14/03/12 12:26:02 Test DO Ch Use DI Ch (SELECT)	DI ch 1

Press **SELECT** to specify a DO channel number for testing:

14/03/12 12:26:02	
Test DO Ch	DO ch 1
Use DI Ch	
(SELECT)	

Press **SELECT** to specify a DI channel number which is connected to the test DO:

14/03/12 12:26:02	
Test DO Ch	DO ch 1
Use DI Ch	DI ch 1
(SELECT)	

Note: For an external source (relay, sol, etc.), select **NONE**.

14/03/12 12:26:02	
Test DO Ch	DO ch 1
Use DI Ch	NONE
(SELECT)	

When you select the DI channel option, the program displays the current status of the DO and DI.

14/03/12 12:26:02	
Test DO Ch	DO ch 1
Use DI Ch	DI ch 1
DO Current Status	OFF
DI Current Status	OFF
(SEL to toggle Sts)	(STOP to End)

The current status of the DI should match the status of the connected DO channel (if you defined that). If you are using an external device, the system replaces the DI Current Status line with the message *Check Ext. Contact*:

```
14/03/12 12:26:02
Test DO Ch                DO ch 1
Use DI Ch                 NONE

DO Current Status         OFF
<Check Ext Contact>

(SEL to toggle Sts  )     (STOP to End       )
```

Press **SELECT** to toggle the status of the DO channel. The DI status updates accordingly.

If you connected the DO with some external contact (instead of the DI channel), the system updates the DO channel status on the display and changes the label to **DO Current Status** (rather than **DI Current Status**). Check the external contact for the change. The program displays the message *Check Ext. Contact*.

Press **STOP** to end the test for the current channel. The system restores all the original values to the updated TLPs with their original value and redisplays the Select Channel screen:

Affected TLPs

When you select this test, the system sets certain DO and DI module parameters to specific values to perform the test (as noted below). Once you complete the test, the system restores all TLP to the values they had before the test began.

- Put Scanning [101,X,1] into Enabled (1) mode.
- Put Invert Mode [101,X,4] into invert status disabled (0).
- Put Latch Mode [101,X,5] into latch status disabled (0).
- Put Scan time [101,X,13] to 0.005.
- Put Scanning Mode [102,X,2] into Manual (2).
- Put Momentary Mode [102,X,10] into Momentary disabled (0).
- Put Toggle Mode [102,X,12] into Toggle disabled (0).
- Timed Discrete Output Mode [102,X,13] into TDO disabled (0).
- Manual output [102,X,21]

E.5.2 Diagnosing Digital Inputs (DI)

Note: The preset must have an installed DI module to diagnose the DI. If no DI module is present, the system displays the *No DI Card in system* error message.

Hardware/ Wiring

You can either connect a DO channel with the DI channel to be tested or connect to an external source. See *Figure E–9*.

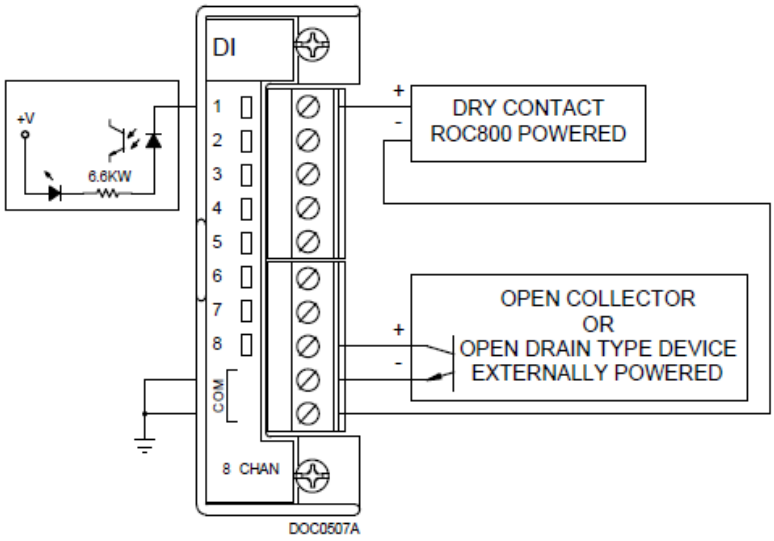


Figure E-9. DI Module Field Wiring

Select **DI** to perform DI diagnostics:

14/03/12 12:26:02 For traversing use UP | DOWN LEFT | RIGHT ENTER to continue EXIT to Go Back EXIT to quit	DO DI AO AI ACIO RS232 (Pg:1/2)

The system displays a channel selection screen.

14/03/12 12:26:02 Test DI Ch Use DO Ch (SELECT)	DI ch 1

Specify the DI channel for testing.

Specify (in the **Use DO Ch** field) the number of the channel used to test the DI.

14/03/12 12:26:02	
Test DI Ch	DI ch 1
Use DO Ch	DO ch 1
(SELECT)	

Note: For an external source, select **None**.

14/03/12 12:26:02	
Test DI Ch	DI ch 1
Use DO Ch	NONE
(SELECT)	

When you select the DO channel option, the program displays the current status of the DI and DO.

14/03/12 12:26:02	
Test DI Ch	DI ch 1
Use DO Ch	NONE
DI Current Status	OFF
DO Current Status	OFF
(SEL to toggle Sts)	(STOP to End)

The status of the DI should match either the status of the connected DO channel (if you selected a DO) or the external status of the external source.

Press **SELECT** to toggle the status of DO channel. The DI status should update accordingly. (This option is available **only** if you select the DO channel.).

Press **STOP** to end the test for current channel. It restores all the original values to the updated TLPs and redisplays the Select Channel screen:

14/03/12 12:26:02	
Test DI Ch	DI ch 1
Use DO Ch	
(SELECT)	

If you used an external resource for the DO (the Use DO Ch option is **None**), the DI channel status updates according to the external contact. The system displays the following screen:

14/03/12 12:26:02	
Test DI Ch	DI ch 1
Use DO Ch	NONE
DI Current Status	OFF
<Use Ext. Source	
	(STOP to End)

The preset continually refreshes the DI status every second.

Affected TLPs

When you select this test, the system sets certain parameters to specific values to perform the test (as noted below). Once you complete the test, the system restores all TLP to the values they had before the test began.

- Put Scanning [101,x,1] into Enabled (1) mode.
- Put Invert Mode [101,X,4] into invert status disabled (0).
- Put Latch Mode [101,X,5] into latch status disabled (0).
- Put Scan time [101,X,13] to 0.005.
- Put Scanning Mode [102,X,2] in to Manual (2).
- Put Momentary Mode [102,X,10] into Momentary disabled (0).
- Put Toggle Mode [102,X,12] into Toggle disabled (0).
- Timed Discrete Output Mode [102,X,13] into TDO disabled (0).
- Manual output [102,X,21]

E.5.3 Diagnosing Analog Outputs (AO)

Note: The preset must have an installed AO module to diagnose the AO. If no AO module is present, the system displays a *No AO Card in system* error message.

Hardware/ Wiring

You can connect an AI channel with the AO channel to be tested, or connect to an external analog meter. See *Figure E–10*.

Note: Connect a 250 Ω precision resistor (as shown) if the AI channel carries a 4–20 mA signal.

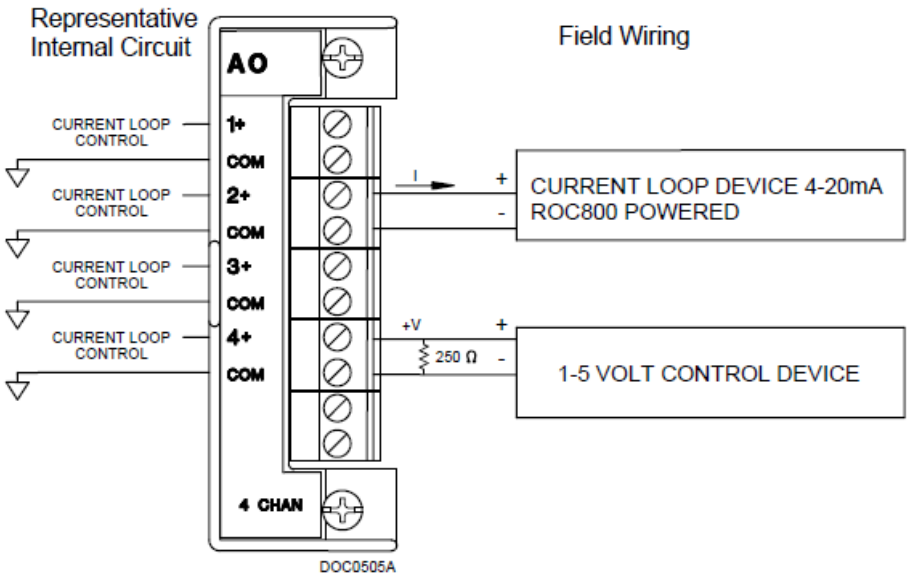


Figure E-10. AO Module Field Wiring

Select **AO** to perform AO diagnostics:

14/03/12 12:26:02 For traversing use UP | DOWN LEFT | RIGHT ENTER to continue EXIT to Go Back EXIT to quit	DO DI AO AI ACIO RS232 (Pg:1/2)

The system displays a channel selection screen.

14/03/12 12:26:02 Test AO Ch Use AI Ch (SELECT)	AO ch 1

Specify the AO channel for testing.

Specify (in the **Use AI Ch** field) the number of the AI channel to connect to the AO:

14/03/12 12:26:02	
Test AO Ch	AO ch 1
Use AI Ch	AI ch 1
(SELECT)	

Note: For an external source, select **NONE**.

14/03/12 12:26:02	
Test AO Ch	AO ch 1
Use AI Ch	NONE
(SELECT)	

Press **ENTER** to proceed. The system displays the AO EU value range (high and low values) and the AI EU value range (high and low values). This enables you to define a signal within the valid range.

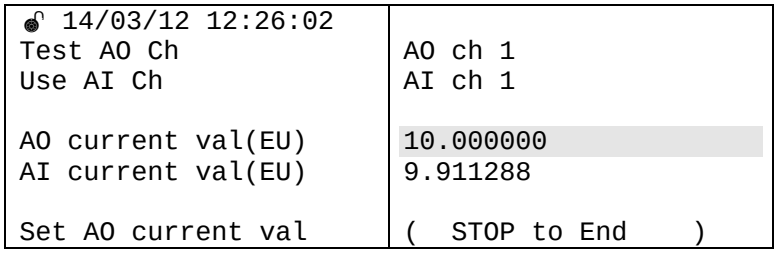
14/03/12 12:26:02	
Test AO Ch	AO ch 1
Use AI Ch	AI ch 1
AO EU value range ->	0.000 to 100.000
AI EU value range ->	0.000 to 100.000
(ENTER to continue)	EXIT to Go Back

Note: If you are using an external resource for analog input, the system displays **only** the AO EU value range:

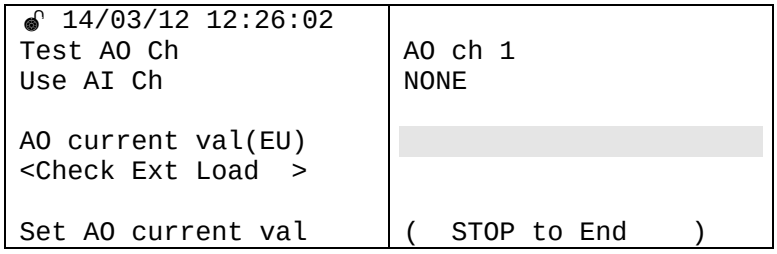
14/03/12 12:26:02	
Test AO Ch	AO ch 1
Use AI Ch	AI ch 1
AO EU value range ->	0.000 to 100.000
(ENTER to continue)	EXIT to Go Back

Press **ENTER.** The system prompts you to provide a value for the selected AO range. The system changes the displayed AI values in response to the AO value you enter.

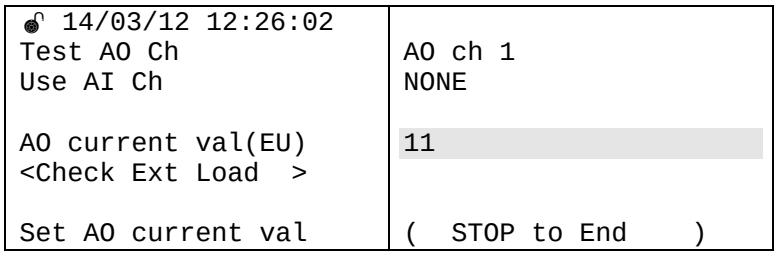
(Press **EXIT** to redisplay the AO channel selection screen.)



Note: If you are using an external resource for analog input, the system displays **only** the AO current value and replaces the AI current value with the message *Check Ext Load*:



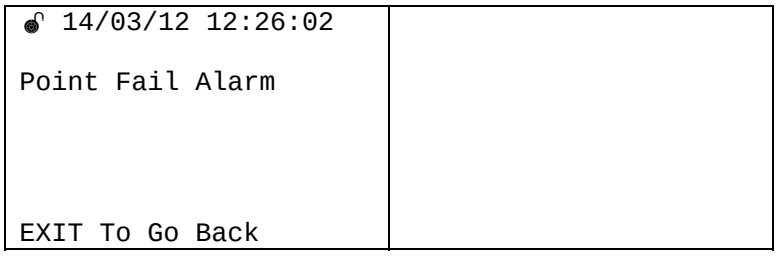
In this case, you enter an AO current value and check the externally connected load.



Press **STOP** to end the test for the current channel and select a new channel to test.

Point Fail Alarm

When you select an AO module for diagnostics, the system checks for point fail alarms. If a point fail alarm occurs, the program prompts you to exit the diagnostic process.



When you press **EXIT**, the Select Channel screen redisplays. If there is no point alarm, you can select a channel and continue with the diagnostic process.

Once the diagnosis is in process, the program checks only for the following AI alarms:

- Point fail alarm. (Terminate diagnostics)
- Scanning manual alarm (Info alarm)

If multiple alarms occur, the system displays the alarm with the highest priority. In this case, the Point Fail alarm has the highest priority, and immediately terminated the diagnostic process.

While the diagnostic process is in progress, the system does not consider alarms for the module under test.

Note: If the AO is connected to some external contact such as a digital multi-meter, the results appear on the multi-meter instead of the preset display.

Affected TLPs

When you select this test, the system sets certain AI and AO module parameters to specific values to perform the test (as noted below). Once you complete the test, the system restores all TLP to the values they had before the test began.

- Scanning [103,X,02]
- Zero EU [103,X,13]
- Mid Point EU #1 [103,X,14]
- Mid Point EU #1 [103,X,5]
- Mid Point EU #1 [103,X,16]
- Span EU [103,X,17]
- Scanning Mode [104,X,2]
- Zero EU [104,X,10]
- Span EU [104,X,1]
- Manual Value [104,X,4]

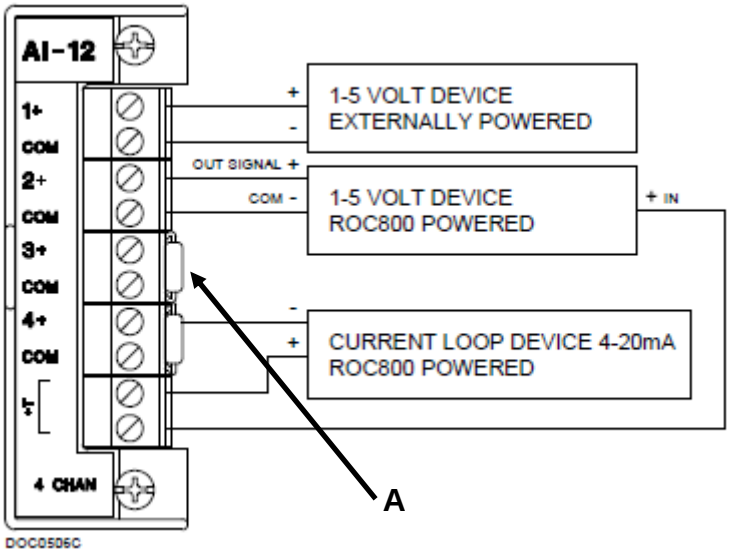
E.5.4 Diagnosing Analog Inputs (AI)

Note: The preset must have an installed AI module to diagnose the AI. If no AI module is present, the system displays a *No AI Card in system* error message.

Hardware/ Wiring

You can connect an AO channel with the AI channel to be tested, or connect to an external analog source. See *Figure E–11*.

Note: Connect a 250 Ω precision resistor (as shown) if the AI channel carries a 4–20 mA signal.



A. 250 Ohm precision resistor

Figure E-11. AI Module Field Wiring

Select **AI** to perform AI diagnostics:

14/03/12 12:26:02 For traversing use UP | DOWN LEFT | RIGHT ENTER to continue EXIT to Go Back EXIT to quit	 DO DI AO AI ACIO RS232 (Pg:1/2)

The system displays a channel selection screen.

14/03/12 12:26:02 Test AI Ch Use AO Ch (SELECT)	 AI ch 1

Specify the AI channel for testing.

Specify (in the **Use AO Ch** field) the number of the AO channel to connect to the AI:

14/03/12 12:26:02	
Test AI Ch	AI ch 1
Use AO Ch	AO ch 1
(SELECT)	

Note: For an external source, select **NONE**.

14/03/12 12:26:02	
Test AI Ch	AI ch 1
Use AO Ch	NONE
(SELECT)	

Press **ENTER** to proceed. The system displays the AI EU value range (high and low values) and the AO EU value range (high and low values). This enables you to define a signal within the valid range.

14/03/12 12:26:02	
Test AI Ch	AI ch 1
Use AO Ch	AO ch 1
AI EU value range ->	0.000 to 100.000
AO EU value range ->	0.000 to 100.000
(ENTER to continue)	EXIT to Go Back

Note: If you are using an external resource for analog input, the system displays only the AI EU value range:

14/03/12 12:26:02	
Test AI Ch	AI ch 1
Use AO Ch	AO ch 1
AI EU value range ->	0.000 to 100.000
(ENTER to continue)	EXIT to Go Back

If you press **ENTER**, the screen enables you to provide a value for the selected AI channel. You can also enter different values for the AO current value. The system changes the AI current value in response.

(Press **EXIT** to redisplay the analog input selection screen.)

```
14/03/12 12:26:02
Test AI Ch                AI ch 1
Use AO Ch                 AO ch 1

AI current val(EU)        99.969406
AO current val(EU)

Set AO current val        (  STOP to End    )
```

Note: If you are using an external resource for analog input, the system displays **only** the AI current EU value:

```
14/03/12 12:26:02
Test AI Ch                AI ch 1
Use AO Ch                 AO ch 1

AI current val(EU)        99.969406
< Use Ext Source>


                          (  STOP to End    )
```

You must vary external AO values and check the corresponding changes in the value the AI channel reads. The program does not display the informational message *Set AO channel value*, but displays *Use Ext Source* instead.

Press **STOP** to end test for current channel and select new test channel.

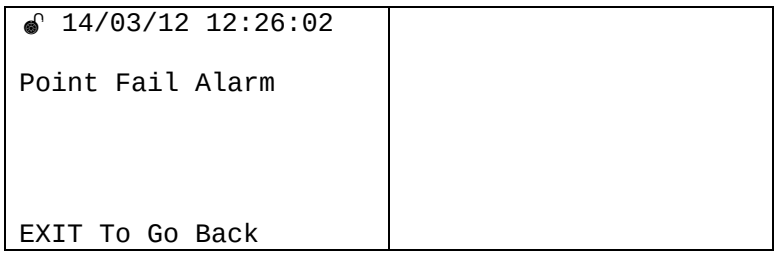
When you select an AI module channel for diagnostics, the program checks for point fail alarms. If point fail alarms occur during the diagnostic test, the program prompts you to exit the test. When you press **EXIT**, the system redisplays the channel selection screen.

AI Alarms

When the diagnostic test is running, the program checks only for the following AI alarms:

- Point fail alarm. (Terminate diagnostics)
- Low alarm (info alarm)
- Low low alarm (info alarm)
- High alarm (info alarm)
- High high alarm (info alarm)

If multiple alarms occur, the system displays the alarm with the highest priority on the screen. In this case, a point fail alarm has the highest priority, and its occurrence immediately terminates the diagnostic test:



Additionally, the system does not show any alarms for the AI module once diagnostics tests are in progress.

Note: If you connect the AI with an external contact instead of an AO channel, the current AI value updates with the external contact.

Affected TLPs

When you select this test, the system sets certain AI and AO module parameters to specific values to perform the test (as noted below). Once you complete the test, the system restores all TLP to the values they had before the test began.

- Scanning [103,X,02]
- Zero EU [103,X,13]
- Mid Point EU #1 [103,X,14]
- Mid Point EU #1 [103,X,15]
- Mid Point EU #1 [103,X,16]
- Span EU [103,X,17]
- Scanning Mode [104,X,2]
- Zero EU [104,X,10]
- Span EU [104,X,11]
- Manual Value [104,X,14]

E.5.5 Diagnosing AC Input/Outputs (AC I/O)

Note: The preset must have an installed AC I/O module to diagnose the AC I/O. If no AC I/O module is present, the system displays the *No ACIO Card in system* error message.

Hardware/ Wiring

Connect the AC output channel with AC load and provide an AC supply (110 V or 230 V) to the AC I/O module. To test the AC output, you need to select channels as output channel on the AC I/O module using DIP switches on the module. (Refer to *Chapter 3* of this manual for more information on the DIP switch settings on the AC I/O module.) See *Figures E–12* and *E-13*.

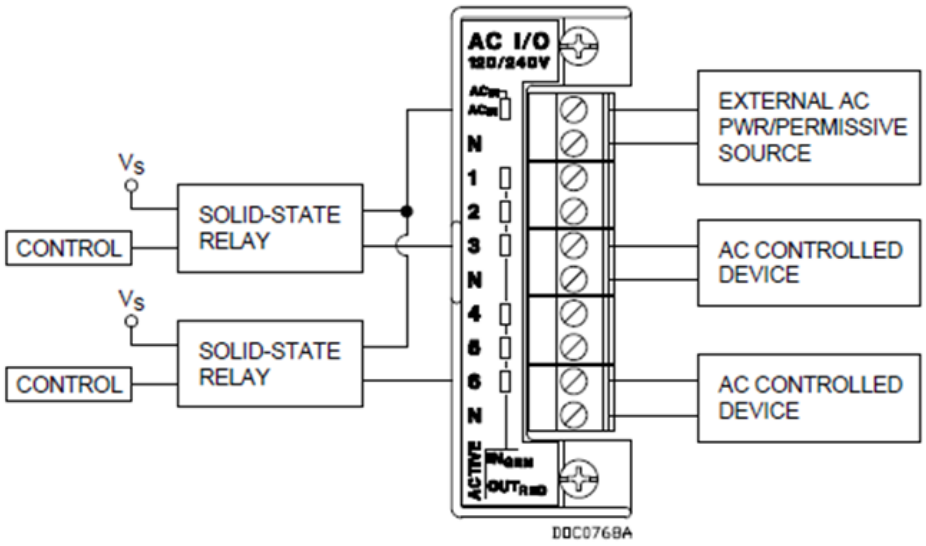


Figure E-12. AC I/O Module Output Field Wiring

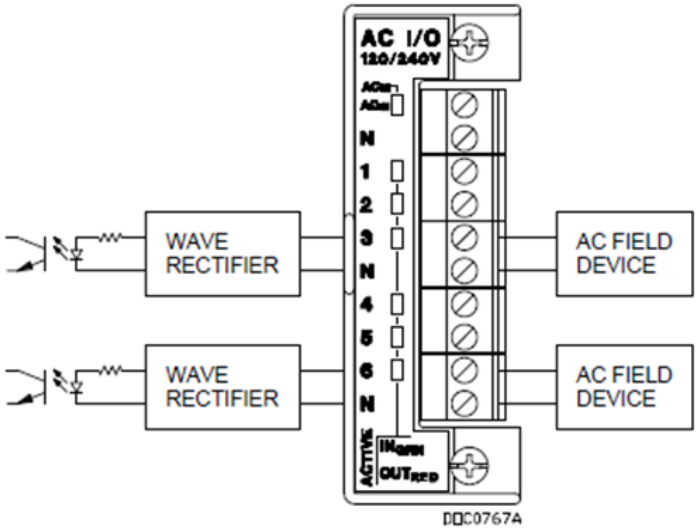
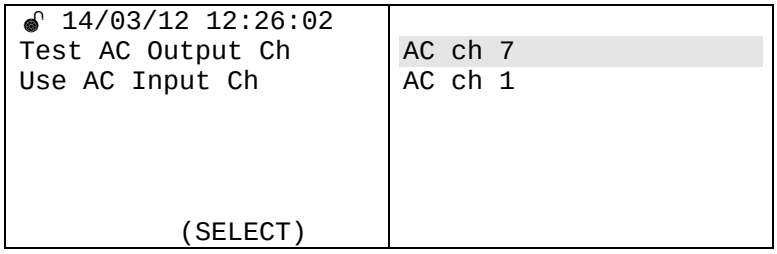


Figure E-13. AC I/O Module Input Field Wiring

Select **ACIO** to perform AC I/O diagnostics:

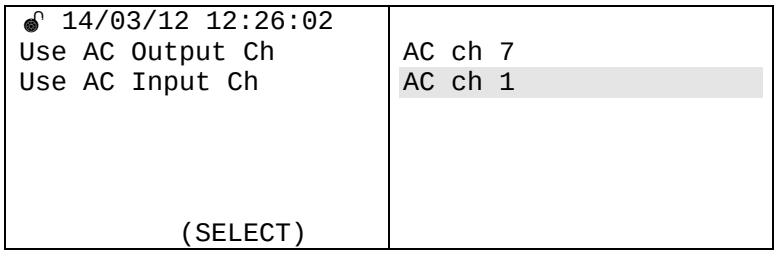
14/03/12 12:26:02	
For traversing use	DO
UP | DOWN	DI
LEFT | RIGHT	AO
ENTER to continue	AI
EXIT to Go Back	ACIO
EXIT to quit	RS232
	(Pg:1/2)

The system displays a channel selection screen.



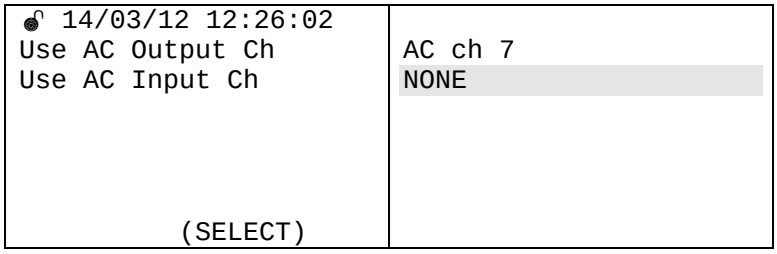
Specify the ACIO channel for testing. You can test only the AC ouput, only the AC input, or both AC output and input.

To test the AC output, press **SELECT** to specify an AC output channel. Selecting an AC input is optional, but if you select an AC input you must also provide an external loop. In that case, the following screen displays:

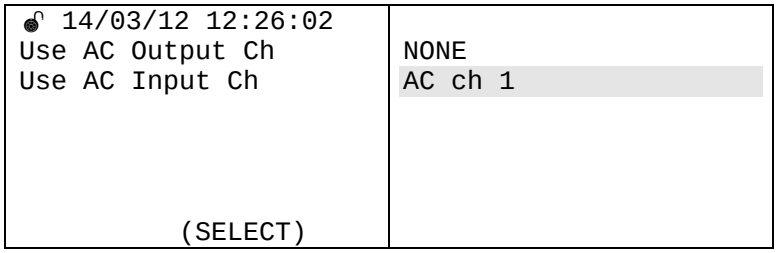


You can test the AC output and AC input at the same time by creating a loop-back connection and selecting the appropriate channels.

If you use an external device for testing, specify **NONE** for the AC input channel. The system then indicates the channel. If you use an external device to text, specify **NONE** for the AC input channel, and the program displays the message *Check Ext Contact*.



If you use an external resource to perform AC Input testing, specify **NONE** for **Use AC Output Ch**:



If you define an internal AC I/O module for **both** AC input **and** AC output, after you select the required channels press **ENTER** to start the diagnostics:

14/03/12 12:26:02	
Use AC Output Ch	Ac ch 7
Use AC Input Ch	AC ch 1
AC O/p curr Sts	ON
AC I/p curr Sts	ON
(SEL to toggle Sts)	(STOP to End)

Press **SELECT** to toggle the status of AC output channel. The status of the AC load/AC input should change accordingly.

Press **STOP** to end the test for the current channel and to then select a new channel for test.

The AC I/O module detects the input and output channels of connected modules and shows these values during channel selection. For example, if you set three channels on an AC I/O module to input and three channels to output, the program displays channels 1-3 as inputs and channels 4-6 as outputs.

Affected TLPs

When you select this test, the system sets certain ACIO module parameters to specific values to perform the test (as noted below). Once you complete the test, the system restores all TLP to the values they had before the test began.

- Channel Mode [140,X,2]
- Scanning Input [140,X,3]
- Input Invert Mode [140,X,9]
- Latch Mode [140,X,10]
- Scanning Output [140,X,18]
- Manual Output [140,X,20]
- Momentary Mode [140,X,25]
- Toggle Mode [140,X,27]
- Times Discrete Output (TDO) Mode [140,X,28]
- Invert Output Mode [140,X,29]

If you set both channels to **NONE**, the program performs no diagnostics and displays the *Config Error* message:

14/03/12 12:26:02	
Use AC Output Ch	NONE
Use AC Input Ch	NONE
<Config Error >	
AC I/p curr Sts	
(SEL to toggle Sts)	(STOP to End)

If you set **Use AC Output ch** to **NONE** and select an available AC **input** channel, the program interprets this to mean you have connected an external AC output to the selected input. The program displays the message *Use Ext. Source* and shows only the status of the selected ACI Input channel.

14/03/12 12:26:02	
Use AC Output Ch	NONE
Use AC Input Ch	AC ch 1
< Use Ext. Source >	
AC I/p curr Sts	ON
	(STOP to End)

Note: If you use an external source, the program does not display a SELECT option.

If you set **Use AC Output ch** to **NONE** and select an available AC **output** channel, the program interprets this to mean you have connected an external AC output to the external contact. The program displays the message *Check Ext. contact* and enables a SELECT key you can use to toggle the selected AO. The program checks the status of the external contact according to the status of the toggled AC output.

14/03/12 12:26:02	
Use AC Output Ch	AC ch 7
Use AC Input Ch	NONE
AC O/p curr Sts	OFF
< Check Ext Contact >	
(SEL to toggle Sts)	(STOP to End)

E.5.6 Diagnosing RS-232 Communication Ports

Note: The preset must have an installed RS-232 module to diagnose the RS-232 communications. If no RS-232 module is present, the system displays a *No RS232 Card in system* error message.

Hardware/ Wiring Connect the RX and TX pins of the port you want to test.

Select **RS232** to test RS-232 communications:

14/03/12 12:26:02 For traversing use UP | DOWN LEFT | RIGHT ENTER to continue EXIT to Go Back EXIT to quit	DO DI AO AI ACIO RS232 (Pg:1/2)

The system displays a comm. port selection screen.

14/03/12 12:26:02 Set Port (SELECT)	RS232 ch 1

Press **SELECT** to specify the number of the comm port.

After selecting the port, press **START** to begin the diagnostics. The system displays the following screen:

14/03/12 12:26:02 Set Port Rx Bytes / Tx Bytes Baud rates Par/StopBit/DataBit (START to Test) (STOP to End)	RS232 ch 1

As the test progresses, the preset sends raw bytes from the TX line that are received on the RX line and updates the values displayed on this screen. This display verifies that all data sent is correctly transmitted.

14/03/12 12:26:02 Set Port Rx Bytes / Tx Bytes Baud rates Par/StopBit/DataBit Diag. in progress… Please Wait…	RS232 ch 1 120/120

Note: Once you start the test, you cannot stop it. You must wait until it completes.

After the transmission portion of the test completes, the system tests all baud rates, from lowest to highest. (Baud rates checked include 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, and 57600). As the test of each baud rate completes successfully, the system adds a **P** (for passed) to the display. Any rates that fail are noted with an **F**.

14/03/12 12:26:02	
Set Port	RS232 ch 1
Rx Bytes / Tx Bytes	120/120
Baud rates	PPPPPPPPP
Par/StopBit/DataBit	
Diag. in progress…	
Please Wait…	

The system also tests parity bits, stop bits, and data bits, again using **P** to indicate a successful test and **F** to indicate a failure. When the test completes the message *STOP to End* appears at the bottom of the screen:

14/03/12 12:26:02	
Set Port	RS232 ch 1
Rx Bytes / Tx Bytes	120/120
Baud rates	PPPPPPPPP
Par/StopBit/DataBit	PPP
(STOP to End)	

Press **STOP** to end the test and return to the comm port selection screen. Press **EXIT** to display the Diagnostics main menu.

E.5.7 Diagnosing RS-485 Communication Ports

Note: The preset must have an installed RS-485 module to diagnose the RS-485 communications. If no RS-485 module is present, the system displays a *No RS485 Card in system* error message.

Since RS-485 is a half-duplex communication mode, you need **two** modules to test RS-485 communications. Set the two modules in **half-duplex un-terminated** mode, as shown in *Figure E-14* and *Table E-9*:

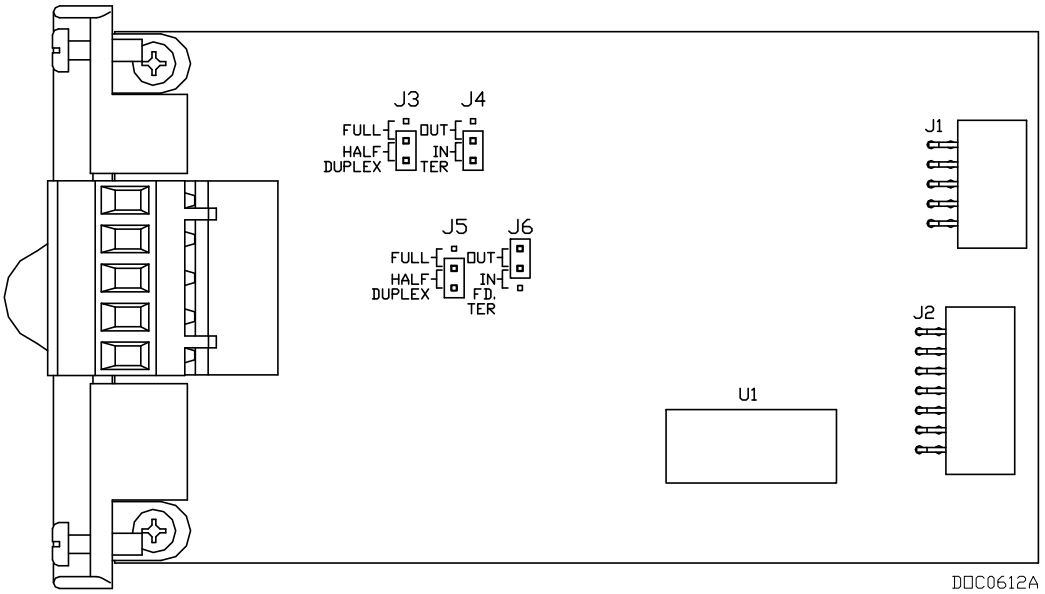


Figure E-14. Jumpers on RS-485 Module

Table E-9. Jumper Settings on RS-485 Module for Half-duplex Unterminated Mode

Jumper	Terminated				Not Terminated			
	TER	Out	Half	Full	TER	Out	Half	Full
J3			x				x	
J4	x					x		
J5			x				x	
J6		x				x		

Hardware/ Wiring Connect the two RS-485 modules to perform external loopback connections, as shown in *Figure E-15* and *Table E-10*:

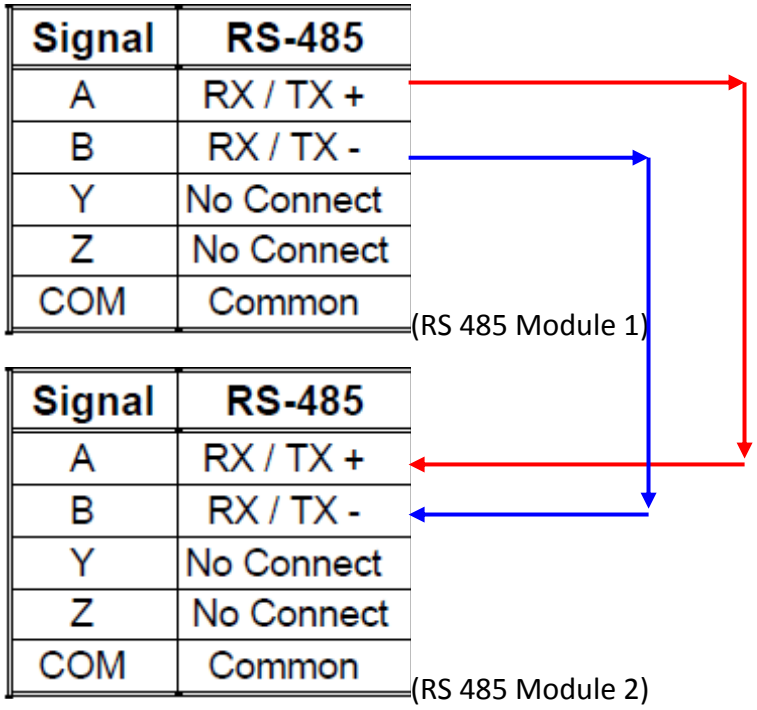
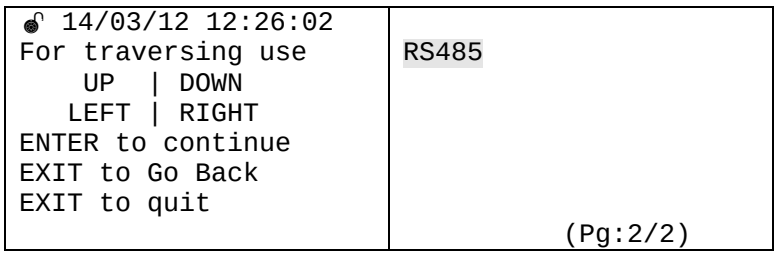


Figure E-15. Two RS-485 Modules with Loopback Connection

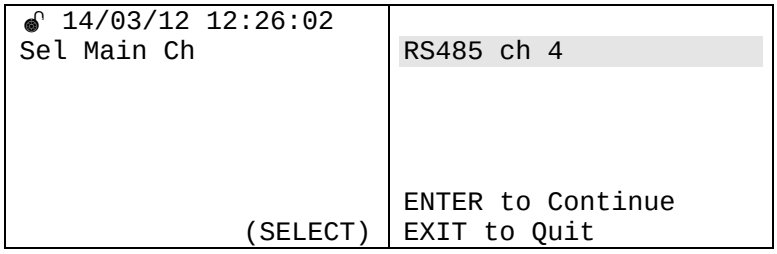
Table E-10. RS-485 Module Signals

Signal	RS-485	Function	Terminal
A	RX / TX +	Lit when module (Comm3, Comm4, or Comm5) is currently receiving.	1
B	RX / TX –	Lit when module (Comm3, Comm4, or Comm5) is currently transmitting.	2
Y	No Connect	None.	3
Z	No Connect	None.	4
COM	Common	Ground.	5

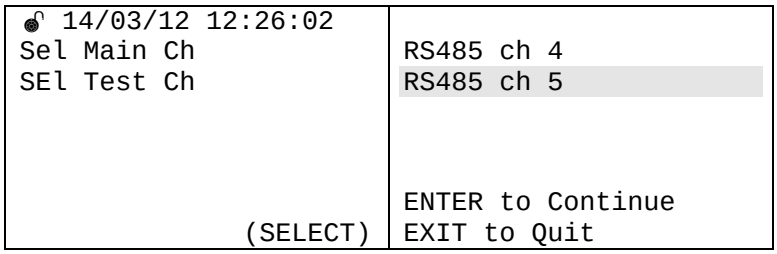
Select **RS485** (which appears on the second page of the menu) to test RS-485 communications:



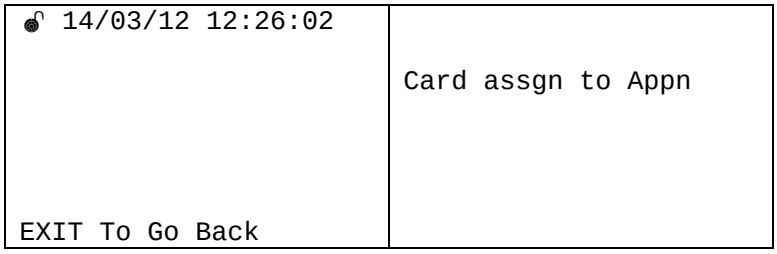
Press **SELECT** to specify a main channel for the test.



Press **ENTER** to continue (or press EXIT to redisplay the main Configuration menu). The system prompts you to select a test channel.

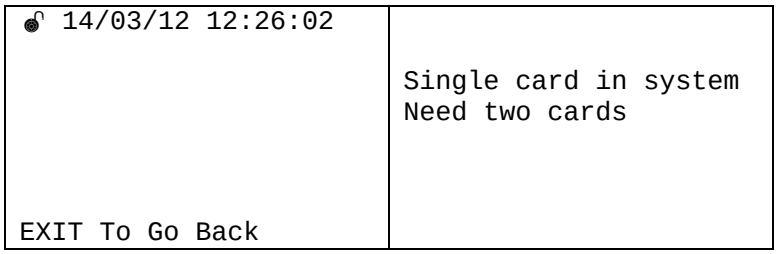


If the installed RS-485 module is currently assigned to an application (and therefore unavailable to test), the following message displays:



Press **EXIT** to end the test process. Once you un-assign the module, you can restart the test.

If only one RS-485 module is installed, the following message displays:



Press **EXIT** to end the test process. Once you install a second RS-485 module, you can restart the test.

Once you have at least **two** RS-485 modules installed **and** both are **un-assigned** to any application **and** you have defined both a main and a test channel, the following screen displays:

14/03/12 12:26:02 Set Port Rx Bytes / Tx Bytes Baud rates Par/StopBit/DataBit (START to Test) (STOP to End)	RS485 ch 4

Press **START** to begin the diagnostic test. (Press **STOP** to exit the RS-485 test.) The following screen displays: -

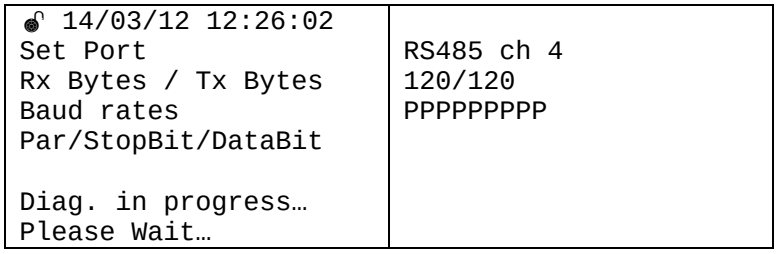
14/03/12 12:26:02 Set Port Rx Bytes / Tx Bytes Baud rates Par/StopBit/DataBit Diag. in progress… Please Wait…	RS485 ch 1

As the test progresses, the preset sends raw bytes from the TX line that are received on the RX line and updates the values displayed on this screen. This display verifies that all data sent is correctly transmitted.

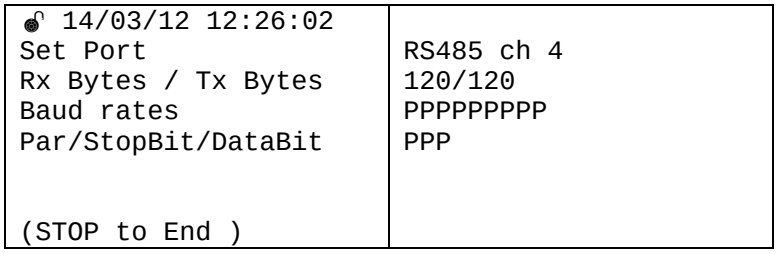
14/03/12 12:26:02 Set Port Rx Bytes / Tx Bytes Baud rates Par/StopBit/DataBit Diag. in progress… Please Wait…	RS485 ch 4 120/120

Note: Once you start the test, you cannot stop it. You must wait until it completes.

After the transmission portion of the test completes, the system tests all baud rates, from lowest to highest. (Baud rates checked include 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, and 57600). As the test of each baud rate completes successfully, the system adds a **P** (for passed) to the display. Any rates that fail are noted with an **F**.



The system also tests parity bits, stop bits, and data bits, again using **P** to indicate a successful test and **F** to indicate a failure. When the test completes the message *STOP to End* appears at the bottom of the screen:



Press **STOP** to end the test and return to the comm port selection screen. Press **EXIT** to display the Diagnostics main menu.

E.5.8 Error Messages

Table *E-11* lists error messages that could appear on the DL8000 display.

Table E-11. Error Messages

Message	Description
Archive Config Err	Transaction or batch configuration error
Blend Toler. Fail	Preset verification failed; component percentages are out of allowed tolerance limit
Btch/Trans Lmt Cros	Preset verification failed; limit on batches per transaction exceeded.
Invd Additive	Additive verification failed
Inv Adtv type	Recipe verification failed; invalid additive type
Invd Comp Ratio	Recipe verification failed; invalid component ratio in selected recipe
Invd Delivery Seq	Recipe verification failed; invalid delivery sequence
Invd Meter	Recipe verification failed; invalid meter assignment
Invd Driver	Invalid driver ID entered
Invd Prset Adtv op	Recipe verification failed; invalid additive preset option
Invd Primary Comp	Recipe verification failed; primary component

Message	Description
	verification failed
Invd Recipe No	Recipe verification failed; invalid recipe number
Invd Vlv	Recipe verification failed; invalid valve assignment
Insuff Comp Preset	Preset verification failed; insufficient component preset
Out of Range	Preset verification failed; entered preset is outside of minimum and maximum preset limits
Power Failure	DL8000 has no power
Trans Limit Cross	Preset verification failed; preset entered exceeds transaction limit
Side not authorized	Selected swing arm side not authorized

E.5.9 Translated Alarm and Status Messages

Table *E-12* lists translated alarm and status messages that could appear on the DL8000 keypad display.

Table E-12. Translated Alarm and Status Messages

English	Spanish	Portuguese
Additive	Aditivo	Aditivo
Comm Fail	Falla comunic	Falha Comunicacao
Config corrupted	Config. corrupta	Configur Corrompid
Vlv Closure Fail	Falla Ctl Valv	Falha Fechar Valv
High Flow	Alto Flujo	Vazao Alta
Inst Blend	Mezcla Inst.	% da Mistura
Intl Temp Fail	Falla Temp. Int.	Falha Temp Interna
Linear Fail	Falla Linear	Falha Linearizacao
Low Flow	Bajo Flujo	Vazao Baixa
MF Deviation	Desv Fact Med	Desvio M.F.
Over Flow Preset	Llenado excesivo	Carreg Excedido
Param Restored	Param.modificado	Param Restaurado
System alarm	Alarm del sistema	Alarme de Sistema
Temp Drift	Desv. Temp.	Variacao Temp
Temp Fail	Falla Temp.	Falha Temp
UnAuth Flow	Flujo no aut.	Vazao Nao Autoriz
UT Cl.Valve	No Cerró Valv.	Imp Fech Valv
UT RampDown	No resp.rampa	Imp Contr Rampa
Blend Fail	Falla Mezcla	Falha na Mistura
Under Flow	Llenado insuf.	Qtde Carreg Baixa
Valve Fail	Falla valvula	Falha Valvula
Dens Fail	Falla Dens.	Falha Densidade
No Flow	Sin Flujo	Sem Vazao

English	Spanish	Portuguese
Pres Fail	Falla Pres.	Falha Pressao
NaN Found	NaN encontrado	Valor N recon
Data Error Found	Error de Datos	Falha de Dados
BV Fail	BV Falla	Falha Valv Bloq
Power failure	Falla Energia	Falha Alimentacao
Pulse Security	Pulso Seguradad	Fidelidade Pulsos
Storage Mem Full	Memoria Llena	Memor quase cheia
Oup Config corrupt	Conf. Corrupta OPU	Configur Invalida
Oup Param Restored	Oup Param modifi.	Configur Restaur
Sto Mem Pre Full	Memoria Completa	Sem Memor Disponiv
Archive Error	Error de Archivo	Erro nos Arquivos
Print Error	Error de Impresion	Erro Impressao
K & D Com. Fail	Falla Com.Pantalla	Falha Comun Tecl
Calc Boundary Alm	Alm Fuer Lim Norma	Alm Fora Lim Norma
Line pack delay	Empacando Linea	Interv Press Linha
Load In Progress	Carga En Progreso	Em Carregamento
Shutting Valve	Cerrando Valvula	Fechando Valvula
Pump Stop Delay	Retraso De Bomba	Tempo Parada Bomba
Batch Halt	Lote En Pausa	Carregam Suspenso
Alarm Halt	Pausa Por Alarma	Alarme Suspenso
Enter New Preset	Progra Nueva Carga	Entrar Nova Qtde
Out Of Range	Fuera De Limites	Fora de Range
Blend Toler. Fail	Falla Toler.Mezcla	Falha % da Mistura
Btch/Trans Lmt Cros	Lotes/Trans Excedi	Limit Ultr Bat/Trs
Please Wait	Favor De Esperar	Por favor Aguarde
Transaction Ended	Transac. Terminada	Trans Terminada
Recipe Selected	Receta Selecionada	Receita Selecion
Timeout Operation	Operacion Expirada	Tempo Esgotado
Transaction Auth	Transac.Autorizada	Transacao Autoriz
Preset Entered	Cantidad Ingresada	Qtde. Inserida
Batch Aborted	Lote Abortado	Carregam Abortado
Batch Ended	Lote Terminado	Carregam Terminado
Batch Complete	Lote Completo	Batelada Concluida
Additive Selected	Aditiv Selecionada	Aditivo Selecion
Data Entered	Datos Ingresados	Dados Inseridos
Invd Recipe No.	No. Receta Invalid	# Receita Invalida
Invd Delivery Seq	Sec. Carga Invalid	Sequencia Invalida
Invd Comp ratio	Razon Comp Invalid	Proporcao Invalida
Invd Meter	Medidor Invalido	Medidor Invalido
Invd Vlv	Valvula Invalida	Valvula Invalida
Invd Primary Comp	Comp.Primari Inval	Comp Prim Invalido

English	Spanish	Portuguese
Flowrate Too High	Flujo muy alto	Vazao muito Alta
Flowrate Too Low	Flujo muy bajo	Vazao muito Baixa
Trans Limit Cross	Lim. Trans Excedid	Lim Trans Excedido
Opening BV	Abrir valv bloq	Abrindo Valv Bloq
Archiving Batch	Archivar Lote	Arquivando Batch
Archiving Transac	Archivar transacc	Arquivando Trans
Archive Config Err	Err Archivo config	Erro Arquivo Conf
(Start to Load)	Start para cargar	Start p/ Carregar
Invd Additive	Selec. Anad. Nula	Aditivo Invalido
Error Side stream	Error flujo de lado	Erro Side Stream
Invd Driver	Camionero Invalido	Motorista Invalido
Side not authorized	Lado no autorizado	Lado Nao Autoriz
Invd Prset Adtv op	Opc.Preset Anad.Nula	Opcao Adit Invalid
Invd Adtv type	Tipo Anadido Nulo	Tipo de Adit Inval
Insuff Comp Preset	PZ Preseteada Escasa	Qtde Preset Insuf
Please Wait	Favor De Esperar	Por favor aguarde
(STOP to Abort)	Stop para abortar	Stop p/ aborta
Start to Load	Start para cargar	Start p/ carregm
Printing Ticket	Imprimiendo Recibo	Imprimindo Ticket
CRC Fail,Wait	Falla de CRC Espere	Falha CRC Aguarde
Prebatch Testing	Prueba Previa Lote	Validando Carreg
Adtv limit exceeded	AdtvLimite Superado	Lim Aditivo Exced
RevMet-Invd DelType	RevMet-InvalEntTipo	Med Rev-Tipo Inval
RevMet-Invd UnitTyp	RevMet-InvalUniTipo	Med Rev-Unid Inval
Log In	Ingresar	Log In
Display Test	Prueba de Pantalla	Teste de Display
About	Acerca De	Sobre
Press START To start test	Pulse START Ini. Pr	Pressione Start \n Para Iniciar Teste
Press STOP To stop test	Pulse STOP Fin Pr.	Pressione Stop \n p/ Parar o Teste
Running	Ejecutando	Executando
Clear Alarms	Borrar Alarmas	Limpar Alarmes
Select Language	Cambie Lengua	Selecionar Idioma
Print Record	Imprimir Registro	Imprimir Registro
Display Setting	Mostrar Ambiente	Ajuste Display
Calibration	Calibración	Calibracao
Current Status	Corriente Estado	Status Atual
Setup/Configuration	configuración	Setup/Configuracao
Diagnostics	Diagnósticos	Diagnosticos
Select from the **\r\n** Following Recipes	Seleccionar Receta de entre las \r\n siguientes	Selecione uma das Receitas

English	Spanish	Portuguese
Invd Recipe	Receta inválida…	Receita Invalida
Press SELECT **\r\n** to Choose	Seleccionar	Press Select p/ Escolher
Enter Preset \r\n Quantity	Ingrese cantidad \r\n a cargar	Entrar Quantidade
Invd Preset…	Cantidad no \r\n válida...	Quantid Preset Inv
Enter PIN	Ingresar NIP	Entre PIN
Choose an Option	Escoger una Opcion	Escolha uma Opcao
Loaded:	Cargado:	Carregado:
Active Alarms	Alarmas Activas	Alarmes Ativos
Backlight Adjust	Ajuste de luz Pant	Ajuste Luz Fundo
Contrast Adjust	Ajuste de Contraste	Ajuste Contraste
Current mode:	Modo Actual:	Mode de Operacao
Current language:	Lenguaje actual:	Idioma Atual
Enter Transaction #	Intro no. de trans.	Inserir Num Trans
Display Test	Prueba de Pantalla	Teste Display
Press START	Pulse START	Pressione Start
To start test	Ini. Pr	Para Iniciar Teste
Press STOP	Pulse STOP	Pressione Stop
To stop test	Fin Pr.	p/ Parar o Teste
(ENTER to Continue)	ENTER para seguir	Enter p/ continuar
(Press CLEAR)	Presione CLEAR	Pressione Clear
(More)	Mas	mais
(Press <- for Menu)	<- para regresar	Aperte <- p/Menu
ALT 3 to Increase	ALT 3 para Subir	ALT+3 p/ Aumentar
ALT 6 to Decrease	ALT 6 para Bajar	ALT+6 p/ Diminuir
SELECT for Default	Selecc. default	Selec p/ default
Please	Favor de	Por Favor
Wait...	Esperar…	Aguarde…
(PRINT for record)	PRINT para grabar	Print p/ Registrar
(SELECT to change)	Cambie con SELECT	Selecione p/ mudar
(EXIT to Quit)	EXIT para salir	Exit para Sair
(ENTER to accept)	ENTER para aceptar	Enter para Aceitar
Error!Invalid Entry	Err!NovalidoEntrada	Err!InvalidoEntrada

Index

3

3- & 4-Wire RTD C-5

A

AC Discrete Inputs 3-20
AC Discrete Outputs 3-19
AC I/O Module
  DIP switches 3-18
ACIO Module to Two-stage Valve C-9
Additive Totalizer (0x11)
  DanLoad 6000 ..... D-44
AI-12 Module 3-7
AI-16 Module 3-7
  DIP switches 3-8
Alarm Log D-89
APM Module
  DIP switches 3-25
APM Module to Daniel 1818A/1838 Dual Turbine Pre-Amps C-7
APM Module to Daniel 1818A/1838 Turbine Pre-Amps C-8
APM Module to Daniel Senior Sonic Meter C-6
APM Module to Micro Motion RFT9739/2400S Transmitters C-4
Asynchronous serial communications 3-39, 3-40
Authorize Batch (0x0A)
  DanLoad 6000 ..... D-39
  Modbus D-21
Authorize Transaction (0x06)
  DanLoad 6000 ..... D-35
  Modbus D-18
AUX+ and AUX– 3-2
AUXSW+ and AUXSW– 3-2

B

BAT+ and BAT– 3-2
Batch Data by Component (0x10)
  DanLoad 6000 ..... D-43
BCC Calcuation D-78
Burst Mode 3-31

C

Change Operating Mode (0x37)
  DanLoad 6000 ..... D-62
  Modbus D-28
Channels
  communication D-2
Clear Display (0x38)
  DanLoad 6000 ..... D-63
  Modbus D-29
Clear Status (0x13)
  DanLoad 6000 ..... D-46
  Modbus D-25
Codes
  Error D-91
  Exception, DanLoad 6000 ..... D-88
Cold Junction Compensation (CJC) 3-27
Communication channels D-2
Communication failures D-2
Communication Protocols D-1
Communications
  Dial-up Modem 3-41
  EIA-232 (RS-232) 3-38
  EIA-422/485 (RS-422/485) 3-39
  Ethernet 3-36
  HART Interface module 3-30
  Modbus B-1
  Modules 3-32
  Ports 3-32
Component Totalizers (0x16)
  DanLoad 6000 ..... D-48
Configure Recipe (0x27)
  DanLoad 6000 ..... D-59
CRC-16 Checksum Table D-79

D

Daniel 1818A Dual Turbine Pre-Amp C-7
Daniel 1818A Turbine Pre-Amp C-2, C-8
Daniel 1838 Dual Turbine Pre-Amp C-7
Daniel 1838 Turbine Pre-Amp C-2, C-8, C-9
Daniel Senior Sonic Meter C-1, C-6
DanLoad 6000 ..... D-1
  Protocol Frame D-77
Devices
  Wiring C-1
DIP switches
  AC I/O 3-18
  AI-16 3-8
  APM 3-25
Display E-1
Display Message (0x1C)
  DanLoad 6000 ..... D-51
  Modbus D-26

E

EIA-232 (RS-232) 3-38
EIA-422/485 (RS-422/485) 3-39
End Batch (0x0D)
  DanLoad 6000 ..... D-41
  Modbus D-22
End Transaction (0x07)
  DanLoad 6000 ..... D-37
  Modbus D-20
Enhanced Request Status (0x3C)
  DanLoad 6000 ..... D-71
Enhanced Start Communications (0x3B)

DanLoad 6000 ..... D-69
Error Codes D-91
Ethernet 3-36
Exception Codes D-86

F

Failure
communication D-2
Field Wiring
AC I/O 3-21, 3-22, 3-23
AI 3-8, 3-9
AO 3-10
APM 3-24
DI 3-11
DO 3-15
DOR 3-16
PI 3-14
Figures
1-1. Typical DL8000 Load Rack 1-2
1-2. DL8000 (in Class I, Zone 1 Enclosure) ... 1-4
2-1. Standard DL8000 Enclosure 2-2
2-2. Standard DL8000 Enclosure 2-3
2-3. Bolt Tightening Sequence 2-5
2-4. Card Cage (with modules) 2-6
2-5. CPU Front View 2-7
2-6. CPU Connectors 2-8
2-7. License Key 2-12
2-8. License Key Installation 2-12
2-9. DL8000 Operator Interface 2-22
2-10. DL8000 Keypad 2-23
3-1. 12 Volt DC Power Input Module 3-2
3-2. Typical I/O Module 3-3
3-3. Optional I/O Module Locations 3-4
3-4. AI-12 Jumper J4 (Shown Set to +12V) ... 3-8
3-5. Analog Input Module Field Wiring 3-8
3-6. AI-16 DIP Switches 3-9
3-7. Analog Output Jumper J4 (Shown Set to +12V) 3-10
3-8. Analog Output Module Field Wiring 3-10
3-9. Discrete Input Module Field Wiring 3-11
3-10. Pulse Input Jumper J4 (Shown Set to +12V) 3-13
3-11. Externally Powered Pulse Input Module Field Wiring 3-13
3-12. DL8000 Powered Pulse Input Module Field Wiring 3-14
3-13. Discrete Output Module Field Wiring .. 3-15
3-14. Discrete Output Relay Module Field Wiring 3-16
3-15. RTD Sensor Wiring Terminal Connections 3-18
3-16. AC I/O DIP Switches 3-19
3-17. AC I/O Module (Output Field Wiring) .. 3-19
3-18. AC I/O Module (Input Field Wiring) 3-20
3-19. Wiring with Multiple AC I/O Modules ... 3-22
3-20. Fuse Wiring with Multiple AC I/O Modules 3-23
3-21. Pulse Input Wiring on APM 3-24
3-22. Micro Motion 7835/7845 Wiring on APM 3-24
3-23. Generic Densitometer Wiring on APM 3-24
3-24. Input Detector Wiring on APM 3-24
3-25. Series Detector Switch (Normally Open) Wiring on APM 3-24
3-26. Series Detector Switch (Normally Closed) Wiring on APM 3-24
3-27. Independent Detector Wiring on APM 3-25
3-28. Two-Pulse Turbine Pulse Input Wiring on APM 3-25
3-29. Pulse Output Wiring on APM 3-25
3-30. DIP Switches on APM 3-26
3-31. Thermocouple Input Module Wiring 3-28
3-32. Ungrounded - Sheathed 3-29
3-33. Grounded 3-29
3-34. Exposed, Ungrounded – Unsheathed . 3-29
3-35. HART-2 Module Input Point-to-Point Wiring 3-32
3-36. HART-2 Module Input Multi-Drop Wiring 3-32
3-37. HART-2 Module Output Wiring 3-32
3-38. Communication Ports 3-33
3-39. RJ-45 Pin Out 3-35
3-40. 10BASE-T Crossover Cable 3-38
3-41. EIA-422/485 J4 Jumper 3-41
B-1. Modbus Configuration – General tab B-2
B-2. Modbus Configuration – Scale Values tab B-5
B-3. Modbus Configuration – History Table tab B-9
B-4. Modbus Configuration - Registers tab . B-14
B-5. Modbus Configuration - Master Table tab B-20
B-6. Modbus Configuration - Master Modem tab B-23
D-1. Modbus Registers D-74
E-1. DL8000 Operator Interface E-1
E-2. DL8000 Keypad E-2
E-3. LCD Screen (Loading Mode) E-5
E-4. Navigation Setup Option E-12
E-5. PINs Screen E-12
E-6. Multiple Flow Rates with a Single Meter Factor E-56
E-7. Multiple Flow Rates with Multiple Meter Factors E-56
E-8. DO Module Field Wiring E-72
E-9. DI Module Field Wiring E-75
E-10. AO Module Field Wiring E-78
E-11. AI Module Field Wiring E-82
E-12. AC I/O Module Output Field Wiring E-86
E-13. AC I/O Module Input Field Wiring E-86
E-14. Jumpers on RS-485 Module E-92
E-15. Two RS-485 Modules with Loopback Connection E-93

G

Get Date and Time (0x28)

DanLoad 6000 ..... D-60
Glossary A-1

H

HART module 3-30
HART Pass-Through license key 3-30
HMI
Ratio blending B-25
Sequential blending B-24

I

I/O Module 3-3
I/O modules
Specifications 3-43
Thermocouple Inputs 3-27
Initialize Transaction Storage (0x20)
DanLoad 6000 ..... D-55
Input Multi-drop wiring
HART-2 module 3-32
Input Point to Point wiring
HART-2 module 3-32

J

Jumpers
EIA-422/485 (RS-422/485) 3-40

K

Keypad E-1

L

Last Key Pressed (0x31)
DanLoad 6000 ..... D-61
Local Operator Interface (LOI) 3-35
Logs
Alarm D-89
LOI
Using 3-36

M

Mapping Modbus Registers D-74
Meter Totalizers (0x15)
DanLoad 6000 ..... D-47
Micro Motion 2400S Transmitter C-3, C-4
Micro Motion RFT9739 Transmitter C-3, C-4
Modbus B-1
Communications Ports B-1
Modbus Protocol D-1
Modbus Registers
Mapping D-74
Modules 3-1
AC I/O 3-18
AI-12 3-7
AI-16 3-7
AO 3-9
APM 3-23
DI 3-10
Dial-up Modem 3-41
DO 3-14
DOR 3-15
EIA-422/485 (RS-422/485) 3-39
I/O 3-3
Installing 3-6
PI 3-12
Power Input 3-1
Removing 3-6
RTD 3-17
Wiring 3-7
Monitoring codes
Ratio blending B-25
Sequential blending B-24
Multiple AC I/O Modules
Wiring 3-21

O

Output wiring
HART-2 module 3-32
Overfill Protection 1-3

P

PI Module to Daniel 1818A/1838 Turbine Pre-Amps C-2
PI Module to Daniel Senior Sonic Meter C-1
PI Module to Micro Motion RFT9739/2400S Transmitters C-3
Port
Local (LOI) 3-35
Power Input Module 3-1
Prompt Additives (0x03)
DanLoad 6000 ..... D-33
Modbus D-17
Prompt Preset Volume (0x08)
DanLoad 6000 ..... D-37
Modbus D-20
Prompt Recipe (0x01)
DanLoad 6000 ..... D-32
Modbus D-16
Protocol Commands
DanLoad 6000
Additive Totalizer (0x11) D-44
Authorize Batch (0x0A) D-39
Authorize Transaction (0x06) D-35
Batch Data by Component (0x10) D-43
Change Operating Mode (0x37) D-62
Clear Display (0x38) D-63
Clear Status (0x13) D-46
Component Totalizers (0x16) D-48
Configure Recipe (0x27) D-59
Display Message (0x1C) D-51
End Batch (0x0D) D-41
End Transaction (0x07) D-37
Enhanced Request Status (0x3C) D-71
Enhanced Start Communications (0x3B) D-69

Get Date and Time (0x28) D-60
Initialize Transaction Storage (0x20) D-55
Last Key Pressed (0x31) D-61
Meter Totalizers (0x15) D-47
Prompt Additives (0x03) D-33
Prompt Preset Volume (0x08) D-37
Prompt Recipe (0x01) D-32
Report Alarm (0x3D) D-73
Request Command Value (0x1A) D-50
Request Firmware Version (0x2A) D-60
Request Keypad Data (0x1D) D-52
Request Meter Values (0x19) D-49
Request Power Fail Date and Time (0x1B) . D-50
Request Preset Volume (0x09) D-38
Request Program Code Values and Attributes (0x22) D-57
Request Selected Additives (0x04) D-34
Request Selected Recipe (0x02) D-33
Request Status (0x12) D-45
Request Stored Batch (0x3A) D-66
Request Stored Transaction (0x39) D-64
Request Transaction Storage Status (0x1E) D-53
Reset Primary Alarms (0x14) D-47
Reset Unit (0x30) D-61
Set Date and Time (0x29) D-60
Set Densities/Gravities (0x0B) D-40
Set Program Code Value (0x23) D-58
Start Communication (0x21) D-56
Start/Restart Batch (0x0E) D-42
Step Batch (0x0F) D-42
Swing Arm Side (0x33) D-62
Timeout Operation (0x05) D-34
Transaction Data by Component (0x1F) .. D-54
Unauthorized Flow (0x17) D-48
Weights & Measures Switch (0x36) D-62
Modbus
Authorize Batch (0x0A) D-21
Authorize Transaction (0x06) D-18
Change Operating Mode (0x37) D-28
Clear Display (0x38) D-29
Clear Status (0x13) D-25
Display Message (0x1C) D-26
End Batch (0x0D) D-22
End Transaction (0x07) D-20
Prompt Additives (0x03) D-17
Prompt Preset Volume (0x08) D-20
Prompt Recipe (0x01) D-16
Report Alarm (0x3D) D-29
Reset Primary Alarms (0x14) D-25
Reset Unit (0x30) D-28
Start/Restart Batch (0x0E) D-23
Stop Batch (0x0F) D-24
Timeout Operation (0x05) D-18
Set Date and Time (0x29) D-27
Protocol Frame
DanLoad 6000 ..... D-77
Protocols
Communication D-1

R

Report Alarm (0x3D)
DanLoad 6000 ..... D-73
Modbus D-29
Request Command Value (0x1A)
DanLoad 6000 ..... D-50
Request Firmware Version (0x2A)
DanLoad 6000 ..... D-60
Request Keypad Data (0x1D)
DanLoad 6000 ..... D-52
Request Meter Values (0x19)
DanLoad 6000 ..... D-49
Request Power Fail Date and Time (0x1B)
DanLoad 6000 ..... D-50
Request Preset Volume (0x09)
DanLoad 6000 ..... D-38
Request Program Code Values and Attributes (0x22)
DanLoad 6000 ..... D-57
Request Selected Additives (0x04)
DanLoad 6000 ..... D-34
Request Selected Recipe (0x02)
DanLoad 6000 ..... D-33
Request Status (0x12)
DanLoad 6000 ..... D-45
Request Stored Batch (0x3A)
DanLoad 6000 ..... D-66
Request Stored Transaction (0x39)
DanLoad 6000 ..... D-64
Request Transaction Storage Status (0x1E)
DanLoad 6000 ..... D-53
Reset Primary Alarms (0x14)
DanLoad 6000 ..... D-47
Modbus D-25
Reset Unit (0x30)
DanLoad 6000 ..... D-61
Modbus D-28
RS-232 (EIA-232) 3-38
RS-422/485 (EIA-422/485) 3-39
RTD Module to 3-/4-Wire RTD C-5

S

Serial communications 3-39, 3-41
Set Date and Time (0x29)
DanLoad 6000 ..... D-60
Modbus D-27
Set Densities/Gravities (0x0B)
DanLoad 6000 ..... D-40
Set Program Code Value (0x23)
DanLoad 6000 ..... D-58
Settings
Jumpers & Termination Resistors (EIA-422/485) 3-40
Solar Panel 3-2

Specifications
I/O modules 3-43
Start Communication (0x21)
DanLoad 6000 ..... D-56
Start/Restart Batch (0x0E)
DanLoad 6000 ..... D-42
Modbus D-23
Status flags D-7, D-14
Status Flags Descriptions D-81
Stop Batch (0x0F)
DanLoad 6000 ..... D-42
Modbus D-24
Swing Arm Side (0x33)
DanLoad 6000 ..... D-62

T

Tables
2-1. CPU Connector Locations 2-8
2-2. STATUS LED Functions 2-9
3-1. 12 Volt DC Power Input Terminal Block Connections 3-3
3-2. 12 Volt DC Power Input Module 3-3
3-3. RTD Signal Routing 3-17
3-4. RTD Wiring 3-18
3-5. Field Wiring Terminals 3-20
3-6. APM DIP Switch Settings 3-26
3-7. Built-in Communications and Optional Communctions Modules 3-33
3-8. Communication LED Indicator Definitions 3-34
3-9. Built-in LOI EIA-232 Signal Routing 3-35
3-10. RJ-45 to EIA-232 (RS-232) Null-modem Cable Signal Routing 3-36
3-11. Ethernet Signal 3-37
3-12. Built-in EIA-232 (RS-232) Signal Routing – Comm2 3-39
3-13. EIA-232 (RS-232) Communication Module Signal Routing – Comm3, Comm4, and Comm5 3-39
3-14. EIA-422 (RS-422) Signal Routing – Comm3, Comm4, and Comm5 3-40
3-15. EIA-485 (RS-485) Signal Routing – Comm3, Comm4, and Comm5 3-40
3-16. EIA-422 (RS-422) Module 3-41
3-17. EIA-485 (RS-485) Module 3-41
3-18. RJ-11 Field Connections 3-42
3-19. Modem Signal Routing – Comm3, Comm4, and Comm5 3-42
3-20. I/O Module Technical Specification 3-43
B-1. RTU Message Framing B-3
B-2. ASCII Message Framing B-3
B-3. Modbus History, Event, and Alarm Functionality B-7
B-4. Modbus Events & Alarms Log Contents B-12
B-5. Events & Alarm Change Bit Map Contents B-12
B-6. Modbus Conversion Codes B-17
B-7. Modbus Function Codes B-19
B-8. Sequential Blending Status Codes B-24
B-9. Ratio Blending B-25
D-1. Modbus Executable Commands D-15
D-2. DanLoad 6000 Commands D-30
D-3. CRC-16 Checksum D-79
D-4. Status Flag Descriptions D-81
D-5. Exception Codes D-86
D-6. New/Unused DanLoad 6000 Exception Codes D-88
D-7. Alarm Logs D-89
D-8. Error Codes D-91
E-1. Key Functions E-3
E-2. LED Indicators E-4
E-3. Loading Screen Status Messages E-9
E-4. Net Totalizers E-10
E-5. Preset Parameter Descriptions E-11
E-6. TLPs in Current Status Menus E-16
E-7. Menus & Submenus in Setup/Configuration E-22
E-8. Parameters and TLPs in Setups/Configuration Menus E-23
E-9. Jumper Settings on RS-485 Module for Half-duplex Unterminated Mode E-92
E-10. RS-485 Module Signals E-93
E-11. Error Messages E-96
E-12. Translated Alarm and Status Messages E-97
Temperature Detector
See Thermocouple Inputs 3-27
Terminology A-1
Thermocouple Inputs 3-27
Timeout Operation (0x05)
DanLoad 6000 ..... D-34
Modbus D-18
Transaction Data by Component (0x1F)
DanLoad 6000 ..... D-54
Two-stage Valve C-9
Typical Load Rack 1-2

U

Unauthorized Flow (0x17)
DanLoad 6000 ..... D-48
Unused DanLoad6000 Exception codes D-88
User Interface E-1

V

Voltage 3-1

W

Weights & Measures Switch (0x36)
DanLoad 6000 ..... D-62
Wiring C-1
3- and 4-Wire RTD C-5
Communication modules 3-34
Daniel Dual Turbine Pre-Amp C-7
Daniel Senior Sonic Meter C-1, C-6

Daniel Turbine Pre-Amp..... C-2, C-8
Micro Motion Transmitters..... C-3, C-4
Multiple AC I/O Modules..... 3-21
Two-stage Valve.....C-9

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